British Society for the Study of Orthodontics

1948

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TRANSACTIONS

OF THE

British Society for the Study of Orthodontics

1948

HEADQUARTERS

Manson House. 26, Portland Place, London, W.1

PUBLISHED FOR THE SOCIETY BY

SAWARD and COMPANY,
1 - 5, HONDURAS ST., LONDON, E.C.1

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OUTLINE OF THE HISTORY OF THE SOCIETY

AT THE END OF THE NINETEENTH CENTURY THE MORE THINKING of the teachers at the dental schools realised the necessity to devise a system on which to base the treatment of irregular teeth and to study the aetiology of such defects. J. H. Badcock was the predominant personality first to lecture on the subject to the students at Guy's. His friend George Northcroft had similar ideas which they discussed with Northcroft's young assistant Harold Chapman, who had taken a course with Edward Angle. Others joined in these discussions at Northcroft's house and stimulated by Chapman the idea of a society crystallised in the famous letter from Northcroft. The first meeting was held December 5th, 1907 at the rooms of The Medical Society of London where the Society met for the next 24 years. The first president was J. H. Badcock followed by George Northcroft who held office a second time in 1929, the coming of age of the Society.

Strong guidance has been given to the activities of the Society by at least two of the honorary secraetries, Harold Chapman for fourteen years and Robert Cutler who held the office for thirteen years ; wonderful records ! Carl Schelling dealt with the Transactions for nineteen years. All of these officers have served as presidents and Chapman has added to other offices that of honorary treasurer in recent years.

The Society is regarded with respect and esteem in international relations and acted as host at the Second International Orthodontic Congress 1931 when J. H. Badcock was chosen as president.

A library and museum have been steadily built up, gifts of cabinets from J. Lewin Payne and H. Chapman are now housed in the Institute of Hygiene until the cherished desire of the Society to have a home of its own is fulfilled.

OFFICERS AND COUNCILLORS, 1948.

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Hon. Editor	Mr. J. F. Pilbeam.
Vice-Presidents	Mr. L. Russell Marsh. Dr. Lilian Lindsay. Mr. H. T. A. McKeag. Mr. R. E. Rix.
Councillors	Mr. G. Parfitt. Mr. J. W. Softley. Mr. H. Richards.

Communications should be addressed to the Honorary Secretary, Mr. Howell Richards.

PAST OFFICERS

PRESIDENTS OF THE B.S.S.O.

1908	J. H. Badcock.
1909	G. Northcroft.
1910	J. Sim Wallace.
1911	Wm. Rushton.
1912	H. Baldwin.
1913	M. F. Hopson.
1914	N. G. Bennett.
1915	W. F. Mellersh.
1916	J. E. Spiller.
1917	
1918	
1919	
1920	G. G. Campion.
1921	J. L. Payne.
1922	S. Spokes.
1923	Warwick James.
1924	Sheldon Friel.
1925	Harold Chapman.
1926	G. F. Cale Matthews.
1927	H. C. Highton.
1928	B. Maxwell Stephens.
1929	G. Northcroft.
1930	H. E. Marsh.
1931	A. T. Pitts.
1932	C. Schelling.
1933	H. G. Watkin.
1934	B. B. Samuel.
1935	A. L. Packham.
1936	F. Bocquet Bull.
1937	F. S. St. J. Steadman.
1938	Mrs. Lindsay.
1939	S. A. Riddett.
1940	
1941	
1942	
1943	
1944	
1945	Norman Gray.
1946	R. E. Rix.
1947	R. Cutler.
1948	M. A. Rushton.
1949	Mr. L. Russell Marsh.

HONORARY SECRETARIES.

1907–1910	A. C. Lockett.
1910–1925	H. Chapman.
1925–1931	A. L. Packham.
1931–1946	R. Cutler.
1946–1948	K. Pringle.
1949	H. Richards.

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1923–1931	W. Ovey.
1931–1932	H. C. Visick.
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1942–	H. Chapman.

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Ainsworth, N. J., 8, Upper Wimpole Street, W.1.
Aldred, A. B., 88, Park Street, Grosvenor Square, W.1.
Apperley, H. G., 12, Chandos Street, Cavendish Square, W.1.
Ball, L. C., 3, Park Crescent, W.1.
Bane, B., 223a, North End Road, S.W.6.
Bell, A. W., 30a, Wimpole Street, W.1.
Beresford, J. S., Eastman Dental Clinic, Grays Inn Road, W.C.1.
Biro, A., 26, Welbeck Street, W.1.
Boutwood, R., 2, Harley Street, W.1.
Bouess, W. L., 12, Maida Vale, W.9.
Bowes, J. A., 28, South Side, Clapham Common, S.W.
Bragg, R. N., 413, Brixton Road, S.W.
Briault E. Barrington, 2, Upper Wimpole Street, W.1.
Brown, Miss D. J., National Dental Hospital, Gt. Portland Street, W.1.
Bull, C., 13, Magdalene House, Manor Fields, Putney, S.W.15.
Bull, F. Bocquet, 15, Upper Wimpole Street, W.1.
Campkin, H. T., 71, Harley Street, W.1.
Caseley, Miss R., Eastman Dental Clinic, Grays Inn Road, W.C.2.
Chapman, H., 6, Upper Wimpole Street, W.1.
Christian, H. B., 1, Rosslyn Hill, Hampstead, N.W.3.
Clarke, J. F. H., 67, Wimpole Street, W.1.
Clarke, N. F., 140, Harley Street, W.1.
Clausen, Mrs. E., Garden Flat, 46, Marlborough Place, N.W.8.
Clinch, Miss L. M., 27, Wimpole Street, W.1.
Cregan, T. C., 121, Harley Street, W.1.
Cutler, R., 8, Lower Sloane Street, S.W.1.
Dey, Miss I. G., 53, Portland Place, W.1.
Doherty, J. W., 140, Harley Street, W.1.
Down, G. R., 9, Harley Street, W.1.
Dowsett, E. B., 12, Gloucester Place, Portman Square, W.1.
Emslie, R. D., 12, Gloucester Place, Portman Square, W.1.
Endicott, C. L., 22, Harcourt House, 19, Cavendish Square, W.1.
Felix, P., 23, Old Manor Court, Abbey Road, N.W.8.
Freeth, H. W. F., 88, Park Street, W.1.
Fry, J. C., 17, Upper Wimpole Street, W.1.
Fry, Miss K. M., 8, Mays Court, Grooms Hill, Greenwich, S.E.10.
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Garrow, A., 115, Harley Street, W.1.
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Henry T. Cradock, 31, Portlan Place, W.1.
Henry, C. J., 73-76, King William Street, E.C.4.
Henry, O. J., 11b, Portland Place, W.1.
Hillyard, V. W. H., 22, Rosslyn Hill, N.W.3.
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Hunt, Miss W. M., 4, High Croft, North Hill, Highgate, N.6.
Jennings, E. A., 1, Castlebar Hill, Ealing, W.5.
Johnson, Mrs. E. M., 156, King Henry's Road, Hampstead.
Johnson, G., 46, Lee Terrace, S.E.3.
Jones, D. Rhys, 121, Harley Street, W.1.
Kettle, M. A., 40, Harley Street, W.1.
Kinghorn, A., 23, Caterham Road, S.E.13.
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McCallin, S., 44a, Sloane Street, S.W.1.
McKechnie, B. G., 2, Harley Ssreet, W.1.
McNamara, T., Orthodontic Clinic, 84, Westhorn Place, Stratford, E.15.
Malleson, M., 30, Thurlow Road, N.W.3.
Markham, H. R., 3, Upper Wimpole Street, W.1.
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Wydell, H. H., 1, Mount Street, Berkeley Square, W.1.
Young, Miss E. M., 55, Eton Rise, Eton College Road, N.W.3.

PROVINCIAL MEMBERS.

Berkshire.

Archibald, H. M. D., 39, London Road, Reading.
Butchart, J. S., 14, High Street, Windsor.
Ellingham, G. H., 39, London Road, Reading.
Inman, J. E., Beechcroft, Wokingham.
Loretz, Miss M. M., Green Meadows, Ascot.
Parfitt, G. J., 179, Kings Road, Reading.

Cheshire.

Appleton, J., Glenburn, Marple Bridge, Stockport.

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Trays, W. N. 3, Downs View, Bude.

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Dagger, H., Devon Villa, Newton Abbott.
Lake, C. P., 3, Northernhay Place, Exeter.
Turner, J. Macdougall, Woodah, Babbacombe Road, Torquay.

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Galinsky, M., 43, Barrington Crescent, Stockton-on-Tees.

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Clarke, A. G., 8, Mornington Avenue, Ilford.
Dick, J. S., 40, Princes Avenue, Woodford Green.
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Sherwood, J., 18, Goodmayse Road, Goodmayes.
Ta'Bois, N. C., 33, High Road, Woodford Green.

Gloucestershire.

Dagger, T., Parabola House, Cheltenham.
Johnson, W., T. Litfield House, Clifton Down, Bristol, 8.
Pickles, R. B., Bristol University Dental Hospital, Lower Maudlin Street, Bristol.
Visick, H. C., 58, Moorend Park Road, Cheltenham.

Hampshire.

Crane, W. A., 4, St. Stephens Road, The Square, Bournemouth.

Hertfordshire.

Buxton, J. L. D., Hill End Emergency Hospital, St. Albans.
Catchpole, O. N., 6a, North Street, Bishops Stortford.
Charles, S. W., Devonia, Rickmansworth.
Daplyn, R. G., 59, Ramsbury Road, St. Albans.
Smallbone, N. L., 4, Arden Grove, Harpenden.
Warburton, D. U., 107, Norton Way, Letchworth.

Kent.

Buchan, A., 117, Newlands Road, Tunbridge Wells.
Cross, Miss M., 48, London Road, Tunbridge Wells.
Dickson, G. C., 37, Shepway Avenue, Maidstone.
Edey, G. R., 83, High Street, Bromley.
Glen, J. H., 36, Kings Avenue, Bromley.
Hooper, K., 8, Copers Cope Road, Beckenham.
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Page, C. Scott, 65, Mount Ephraim, Tunbridge Wells.
Pain, A., 33, Earls Avenue, Folkestone.

Lancashire.

Angelman, J., 41, Rodney Street, Liverpool. 1.
Batten, A. J., School Medical Dept., Education Offices, Deansgate, Manchester 3.
Bourne, S., 2, St. John Street, Manchester 3.
Broadbent, B. T., Turner Dental School, Manchester.
Burston, W. R. B., 15, Somerville Road, Wigan.
Capon, P. G., 49a, Rodney Street, Liverpool.
Ewart, Miss L. M. V., 9, Eversleigh Park, Chester.
McCracken, J. I., 27, Princes Avenue, Liverpool 8.
Mellor, W. C., 167, Bury New Road, Whitefield, Manchester.
Patterson, T. B., 84, Station Road, South Shore, Blackpool.
Robb, G. C., 22, Houghton Street, Southport.
Sawley, J. N., 49, Newsham Drive, Liverpool 6.
Softley, J. W., 25, Druidsville Road, Liverpool. 18.
Stones, Prof. H. H., School of Dental Surgery, Boundary Place, Liverpool 7.
Watkin, H. G., 84, Rodney Street, Liverpool.
Wild, N., 370, Hollins Road, Oldham.
Wilkinson, Prof. C. F., Dental Hospital, Manchester.

Leicestershire.

Downing, F. J., "Carisbrooke," 165, London Road, Leicester.
Rowlett, A. E., "Carisbrooke," 165, London Road, Leicester.
Rowlett, J. A. T., "Carisbrooke," 165, London Road, Leicester.

Middlesex.

Buck, N. H., 25, Chalkhill Road, Wembley Park.
Eady, B., "Maribar," East End Way, Pinner.
Frischmann, I., 47, Peartree Road, Enfield, Middx.
Hobdell, H. G., Barclays Bank Chambers, 355, Station Road, Harrow.
Hudson, J. A., Glenfield, 431, Pinner Road, Harrow.
Mandeville, L. C., 79, Eastcote Road, Ruislip.
Mandiwall, H., 234, Staines Road, Hounslow.
O'Connor, P. D., 126, The Drive, Hounslow.
Pilbeam, J. F., 5, Malpas Drive, Pinner.
Priest, P. D., 325, Willow Road, Enfield.
Rogers, D. A., 24, Manor Park Crescent, Edgware.
Strauss, K., 107, Deansbrook Road, Edgware.
Tait, R. V., Bankside, Wolsey Road, Moor Park.

Montgomeryshire.

Copleton, Mrs. Mary Louise, 67, Clifton Terrace, Newtown, Montgomeryshire.

Norfolk.

Bryan, H., St. Mary's Croft, Chapel Field North, Norwich.
Evans, R. H., Alexandra House, The Park, Gt. Yarmouth.
Tinn, C. A., 5, Euston Road, Great Yarmouth.

Northumberland.

Cooper, E. R., 18, Victoria Square, Newcastle-on-Tyne.
Hallett, G. E. M., 120, Queen's Road, Monkseaton.
Jameson, A., 18, Jesmond Road, Newcastle-on-Tyne.
Littlefield, W. H., 10, Grosvenor Place, North Shields.
Richter, L., 1, Newgate Street, Morpeth.

Nottinghamshire.

Mason, D. E., 44, Trevor Road, West Bridgeford, Notts.
Tredgold, H. V. G., 12, Oxford Street, Notts.

Somerset.

Coates, R. H., Manor Farm House, Norton Sub Handon, Stoke-under-Ham.
Parrott, A. E., Forde House, Upper High Street, Taunton.
Shenton, F. C., The Laurels, Bradford-on-Tone.

Staffordshire.

Holland, N. W. A., 17, Chapel Ash, Wolverhampton.
Salt, H. G., Dental Clinic, Sandford Street, Lichfield.

Surrey.

Bradley, Miss J. A., 25, Elm Way, Worcester Park.
Bulow, C. F. H., 20, Cedar Road, Sutton.
Friend, G. C., Woodbourne, Knoll Rd., Camberley.
Forrest, Miss J. R., L.C.C. Clinic, 2, Presburg Road, New Malden.
Heath, C. A. J., Pinewood House, Worplesdon Hill, Woking.
Hills, W. A. Sowden, 11, Barham Road, South Croydon.
Kelham, Miss M. M., 29, Park Hill, Carshalton.
Laughton, C. H. B., West Lodge, The Green, Esher.
Levin, H., 33, Hill Street, Richmond.
Liddelow, K. P., 80, Carshalton Road, Sutton.
Mayer, J. W., Stedham House, Surbiton Hill.
Miron, G., 175, Kew Road, Richmond.
Oliver, P. G., 34, Whitgift Avenue, South Croydon.
Shepperd, R. J., Dunheved, Pilgrims Way, West Humbel, Dorking.
Smith, G. Richards, Rosslyn, Woking.
Starnes, J. A. G., Dene Lodge, London Road, Guildford.
Titford, K. R., Kingsmead, De Tillens Lane, Limpsfield.
Townley, S. G., Woodbourne, Knoll Road, Camberley.
Turner, Mrs. M., 4, The Ridge, Surbiton.
Wallace, L. J., 15, Hylands Road, Epsom.

Sussex.

Chisholm, I. M. G., Droxford House, Charles Road, St. Leonards-on-Sea.
Gray, N., 16, College Road, Eastbourne.
Harwood, W. U., 21, Second Avenue, Hove 3.
Hooper, J. D., Stanlow, Balcombe Road, Haywards Heath.
Marsh, H. E., 1, Cantelupe Road, Bexhill.
Middleburgh, H., 44, Sackville Road, Hove.
Munns, D., 44, Blackwater Road, Eastbourne.

Warwickshire.

Breakspear, E. K., Central School Clinic, Gulson Road, Coventry.
Cale Matthews, G. F., 54, Newhall Street, Birmingham.
Davis, Mrs. M. H., 8, Prospect Road, Moseley, Birmingham, 13.
Day, A. J. W., 43a, Calthorpe Road, Five Ways, Birmingham.
Hollick, R. L. B., 15, Calthorpe Road, Edgbaston, Birmingham, 15.

Matthews, T., 42, Sheep Street, Stratford-on-Avon.
Roe, S. H., 51, Calthorpe Road, Edgbaston, Birmingham, 15.

Worcestershire.

Godfrey, W. G., Buckingham House, Graham Road, Great Malvern.
Strickland, J. H., Buckingham House, Graham Road, Great Malvern.

Yorkshire.

Gardiner, J. H., 513, Crookesmoor Road, Sheffield, 10.
Sclare, Miss R., 36, Francis Street, Leeds, 7.
Shaw, H., 53, Gledhow Wood Road, Leeds, 8.
Townend, B. R., 131, Manygates Lane, Sandal, Wakefield.
Wood, T. Jason, 6, Mornington Villas, Manningham, Bradford.

SCOTLAND.

Aitchison, J., Glasgow Dental Hospital, Renfrew Street, Glasgow, C.3.
Anderson, H. A., 4, Clifton Place, Sauchiehall Street, Glasgow.
Archibald, W. C., 125, Nethergate, Dundee.
Baker, A., 11, Church Crescent, Dumfries.
Kemball, C. J., 20, Ainslie Place, Edinburgh, 3.
Logan, W. Russell, 8, Chester Street, Edinburgh, 3.
Mears, Miss R. I., 1, Adelaide Terrace, Dundee.
Miller, Miss M. N., 13, Inverleith Place, Edinburgh.
Murray, J., 14, Albyn Place, Aberdeen.
Munro, D., 9, Annfield Place, Glasgow, E.1.
Myers, Miss I. M., Cairnbank, St. Andrews, Fife.
White, T. C., 286, Bath Street, Charing Cross, Glasgow, C.2.

WALES.

Duchesne, H. W., The Gold Thorns, Agergele Road, Colwyn Bay, N. Wales.

IRELAND.

Adams, C. P., 35, Kirkliston Drive, Belfast.
Dockrell, R. B., Termon, Sandycove Avenue, W. Dun Laoghaire, Co. Dublin.
Flanagan, L., 29, Lower Baggott Street, Dublin.
Fitzgerald, G. M., 5, Herbert Road, Ballsbridge, Dublin.
Friel, Dr. S., 3, Fitzwilliam Place, Dublin.
Keith, J. E., 13, Upper Fitzwilliam Street, Dublin.
McKeag, H. T. A., Suite No. 142d, Scottish Provident Buildings, Donegall Square, West Belfsat.
Sterling, Mrs., 13, Upper Fitzwilliam Street, Dublin.

HONORARY MEMBERS.

Badcock, J. H., Priors Close, Walsham-le-Willows, Bury St. Edmonds.
Brash, Prof. J. S., The University, Edinburgh.
Keith, Sir A., Buxton, Browne Farm, Downe, Kent.
James, W. W., 2. Park Crescent, Portland Place, W.1.
Wallace, J. Sim, 14, Church Grove, Hampton Wick, Middx.

CORRESPONDING MEMBERS.

Africa.

De Villiers, J. F., P.O. Box 7668, Johannesburg, South Africa.
Maister, H. C. L., Shell House, Greenmarket, Sq. Capetown.
Norriskin, J. N., 39, Jenner Chambers, 189, Jeppe Street, Johannesburg.
Williamson, M. M., Nakuru House, P.O. Box 120. Nakuru, Kenya Colony.

Australia.

Adamson, K. T., 111, Collins Street, Melbourne.
Seward, J. T., 55, Collins Street, Melbourne.
Spring, D., 71, Victoria Street, Ballarat, Victoria.
Taylor A. Thornton, 175, Macquarie Street, Sydney.
Wilkinson, W. S., 145, Collins Street, Melbourne.

Belgium.

Patcas, H., Rue des Nerviens, 3, Anvers, Belgium.
De Coster, L., Rue Archimede, 12, Brussels, Belgium.

Burma.

Brears, O. B., 547, Merchant Street, Rangoon.

Canada.

Franklin, G., 1414, Drummond Street, Montreal.

Egypt.

Slama, Dr. N., 127, Queen Nazli Avenue, Cairo.

France.

Beauregardt, A., 8, Avenue de Camoens, Paris.

India.

Ghosh, A. S., 54, Chowringhee, Calcutta.

Finland.

Johanson, Carin, Palkane, Birka.

Norway.

Selmer-Olsen, R., Norges Tannlagehogskole, Oslo.

Sweden.

Granerus, Dr. Ragner, Stortorget, 1 Nassjo.
Palsson, K. F., Stortorget 25, Malmo.
Lundstrom, A., Stureplan, 19, Stockholm.

U.S.A.

Goldstein, M. C., 513, Grant Building, Atlanta, Georgia.
Gosman, S. D., 22, Northlaurel Street, Bridgeton, New Jersey.
Sillman, J. H., 667, Madison Avenue, New York City, N.Y.
Tessier, F. J., 314, State Street, Albany, N.Y.

New Zealand.

Bliss, H. D., Ruatanwha Street, Waipukurau.
Gilbert, G. H., Victoria Chambers, Victoria Street, Christchurch.
Cook, C. C., 33, Jordan Terrace, Mastertown.

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DEFINITION OF ORTHODONTICS

ORTHODONTICS includes the study of the growth and development of the jaws and face particularly, and the body generally, as influencing the position of the teeth ; the study of the action and reaction of internal and external influences on this development, and the prevention and correction of arrested and perverted development.

* * *

THIS definition of orthodontics was given by the Committee appointed by the Society in 1922 to consider and report on the subject of orthodontic education.

* * *

THE definition is apposite to the title of ' The Society for the Study of Odonto-Prosopic Orthopaedics ' as suggested by Dr. G. Northcroft, a founder of the Society in 1907. This title was, however, not agreed and the Society became known as the British Society for the Study of Orthodontics.

SOME ASPECTS OF ANTERO-POSTERIOR GROWTH OF THE MANDIBLE

By PROFESSOR M. A. RUSHTON, M.D., F.D.S.

TEXT-BOOKS of orthodontics contain many different statements about the manner in which antero-posterior growth of the mandible is accomplished, and the effect upon students is a confusing one. Salzmann representing a body of opinion writes in his valuable book (1943) "As shown originally by Hunter and confirmed later by Brash, Schour and others, the mandible does not grow in size by interstitial growth but increases in length by additions (surface appositions) at the posterior margin of the ramus and resorption at its anterior margin . . ." At this point let us observe that no bone in fact increases in length by interstitial growth unless it contains an epiphyseal plate, which of course the mandible does not ; that apposition at the posterior margin of the ascending ramus does not increase the length of the mandible but only increases the prominence at and behind the angle, for the antero-posterior length of this bone depends upon the distance between the condyle and the chin ; and lastly, of course, absorption at the anterior margin of the ascending ramus cannot increase the length of the mandible but can only alter its proportions. A great part of the confusion is due to failure to distinguish in words between the antero-posterior length of the mandible and the antero-posterior length of the alveolar process or of the horizontal ramus (or body) of the bone. Salzmann goes on to say " There is a growth area in the mandible along the junction between the body and the ramus. The ramus apparently becomes resorbed on its internal angle, allowing more room for the teeth, and added bone growth takes place on the external ramus, making the mandible longer." But it has already been admitted that the mandible cannot grow in size by interstitial growth : a bone can only increase in length (unless it has an epiphyseal plate) by apposition on its ends. It is thus quite impossible that growth in the neighbourhood of the angle (the ' external ramus ') should make the mandible longer. That this is an active centre of remodelling is certain and it is open to anyone to refer to this activity as a ' growth area ' if he wishes, though I think the term misleading, but it is not admissable to say that it makes the mandible longer if the increase in length of bone by interstitial ossific growth be admitted to be impossible. All that active growth in the angular region can do is to alter the proportions and shape of the bone in the area ; and by such remodelling the length of the alveolar process, the width and thickness of the bone, prominence of the angle and so on may of course be increased, but the total length of the bone cannot be altered. The matter is made no clearer by a further sentence :

" This growth of the body of the mandible takes place, as previously mentioned, in such a manner as to move forward new bone from the area of growth which is located at the junction of the mandibular body and ramus." Now new bone from the angle region could only be moved forward by two mechanisms : by interstitial bone growth, which does not occur ; or by the whole bone being propelled forward by growth at the posterior surface of the condyle, which does occur. What then becomes of the area of growth near the angle ? It becomes seen in its true perspective as a remodelling zone where the anterior part of the progessively formed ascending ramus is remodelled by absorption and apposition to become an extension of the horizontal ramus or body, the total length of the bone being unaffected. The antero-posterior length of the mandible must thus be due to growth somewhere else than at this area in the middle of the bone. And like all other bones the sites of addition must be at one end, or the other end, or both ends. We must, therefore, turn our attention to growth at the condyle and at the chin.

Considering the importance which is attached to the chin by lay opinion its method of formation and growth seem to have been rather little studied. It is clear that the chin prominence can only be formed in two ways: (1) by the apposition of bone in situ, and (2) by the propulsion of the whole jaw while the incisor alveolar bone grows upwards and, relative to the body of the jaw in the same part, backwards. This second mechanism has had several supporters and among others Salzmann writes: "The basilar part of the mandible continues to move forward under the alveolar portion and thus forms the prominent chin." The correctness of this view will not be contested for I only wish to make the point here that if the second mechanism is that which happens, the growth of the chin cannot increase the length of the jaw but is only one result of apposition at the posterior (condylar) end of the bone. That the first mechanism also happens to some extent is obvious to anyone who examines an antero-posterior section through a child's chin, for the evidence of successive layers of apposition on its anterior surface are to be seen at five years of age for example. The appearance is that the contribution is a very small one. The conclusion, must therefore, be that the increase in antero-posterior length of the mandible is almost entirely due to apposition at the mandibular condyle.

If that be so then there should be evidence of very active apposition in that region during the years of growth and of a change of structure when growth ceases. There should be evidence that excessive growth in that place produces a jaw which is too long and that diminished growth there is found when the jaw is much too short. This evidence is available, and the contributions of Wilson Charles (1925), Brodie (1941), Sicher (1947) and others among whom I may include myself (1944, 1946) seem to leave no doubt that the conclusion is not only probable but is in fact the correct one. Sections through the so-called growth area at the junction of ascending ramus and body of the jaw, on the other hand, show the expected remodelling activities and nothing else. That the remodelling zone at the junction of the ascending ramus with the body of the jaw is of very great importance goes without saying: the rate and extent of remodelling at this point determine the length of the alveolar process and to a great extent the amount of space which will be available for the posterior mandibular teeth. But what determines the rate of that remodelling: is it independent of or dependent upon the rate of growth at the condyle ?

If it were independent then one would expect that factors which influence condylar growth would not necessarily influence the remodelling rate. When condylar growth is arrested or retarded by local injury or disease at the joint what we find is that the remodelling rate is also retarded The alveolar process does not continue to grow backward at the expense of the ascending ramus, and the alveolar process does not continue to grow occlusally because there is no room for it to do so, the failure of growth in the ascending ramus having prevented the development of sufficient intermaxillary space. I think one must conclude provisionally that the remodelling rate in the retromolar area is probably dependent upon the rate of propulsion of the bone away from the glenoid fossa caused by condylar growth, just as the gross remodelling of the end of a long bone to become part of the shaft continues only so long as epiphyseal growth persists.

If such a relationship were clearly demonstrated then a question of great practical importance would at once be raised, for the common failure to develop sufficient length in the lower alveolar arch to accommodate the third molars could be regarded as a function of insufficient condylar growth. Further speculation would not be in place here, and it is enough to say that since growth at the mandibular condyle chiefly determines the antero-posterior length of the mandible the greatest interest must attach to factors which influence growth-rate at that point. Some of these rest upon a genetic basis and determine the extent to which the condylar growth mechanism will react to the various normal agents which promote

growth in other parts of the body. Of this aspect I shall not speak.

A second factor which may influence the growth-rate at the mandibular condyle is the level of functional activity to which the bone and associated parts are subjected. This is a highly controversial matter with which I will not attempt to deal. It is obvious that it is possible for the uninjured side of a mandible to develop to approximately normal size even though disused from an early age, as is seen in many cases of unilateral ankylosis of the temporomandibular joint. But this does not mean that a satisfactory level of activity may not make the difference between approximately complete and really complete development.

A third group of factors which we think especially to influence growth rate at the mandibular condyle is endocrine. The effects of excessive anterior pituitary hormone on the mandible in acromegaly are notorious. Is there any hormone which acts upon the condyle in the opposite manner, reducing the rate of growth ? It is well known that the effects of the pituitary growth hormone upon the long bones can be counteracted and arrested experimentally by the sex hormones, particularly œstrogens, and it is thought very probable that these play a part in causing the fusion of epiphyses and cessation of growth of the long bones which occur at puberty. It is therefore, of interest to know whether the growth of the mandible can be arrested in the same manner. Certain circumstances suggest that as regards œstrogens such might be the case, although it is not to be supposed that the mandible is solely affected among the facial bones any more than it is likely affected in hyperpituitarism in childhood. For example it is believed that antero-posterior growth of the facial bones practically ceases at puberty in girls, several years before it ceases in boys, though we do not know whether this change is the result of œstrogen secretion or merely coincident with sexual maturity and determined independently by some other mechanism. There do not appear to be any records of the effects on jaw growth of removal or destruction of both ovaries in young girls, or of the administration or spontaneous production of excessive quantities of œstrogens, though increased jaw growth in male castrates has been noted. Many dental text-books indeed refer to hypergonadism in girls, but chiefly in connection with the juvenile adreno-genital syndrome, and here the operative hormones are not œstrogens but substances produced by abnormal adrenal glands which are of the nature of androgens. The removal of the ovaries of young kittens is considered by veterinary surgeons to result in an ultimate increase in the size of the jaws and face as well as of the rest of the skeleton. Experimental work on animals has been applied to the possible effects of œstrogens upon the calcification of the teeth but not, so far as I am aware, to the development of the jaws. To obtain some information on this matter I have recently performed two experiments.

Experimental injection of œstrogen: effects on dental tissues and jaws of kittens.

Of a single litter of three female kittens, 45 days of age, one was injected subcutaneously with an œstrogen preparation (Œstroform B.D.H.) for six weeks. The total dosage was 475,000 i.b. units given in amounts of 50,000 units twice a week, rising after three weeks to 75,000 units twice for one week, and then reduced to 50,000 once a week. The experimental kitten ceased to gain weight after the first fortnight, and the experiment terminated after six weeks. Its weight had fallen from a maximum of 850 grams to 650 grams compared with the final weight of 1,100 and 1,150 grams for the two controls.

Radiographs and sections were taken from the left hind limbs and from half-skulls and mandibles.

Results of first experiment.

Long bones of hind limb.

The growth in length of the femur and tibia of the experimental animal were reduced, the measurements being from 7 to 10 per cent. less than in both controls. The epiphyseal plates about the knee joint were thinner, and the tibial tuberosity appeared radiographically to be more advanced in development.

The lower ends of the femurs were examined histologically and in the case of the experimental animal showed changes very similar to those reported by Sutro (1940) to follow the subcutaneous injection of œstrogens in immature mice. The epiphyseal plate was about half the thickness of that of the control animals: this reduction in thickness affected all layers including rather strikingly the layers of provisional calcification and of hypertrophic cartilage cells (*Fig.* 1). There was great vascularity on the diaphyseal side of the epiphyseal cartilage, and the primary bone trabeculæ were few and disorderly and included but little cartilage matrix. There was no excessive endosteal bone formation, however.

The skull in the experimental animal was about 10 per cent. shorter than in the controls but approximately the same height, the brain-case being comparatively little altered. The length of the upper alveolar process from the maxillary tuberosity forward was also about 10 per cent. shorter. The chief difference between the experimental and control skulls was in the degree of forward growth of the facial bones (*Fig.* 2).

The mandible, measured from the condylar surface to the alveolar process in the mid-line, was 10 per cent. shorter in the experimental animal, and the height of the body of the jaw was slightly reduced especially in its posterior part.

Since the first permanent molar at the stage covered by the experiment does not move in relation to the surrounding bone it was thought justifiable to superimpose the crypts of this tooth in radiographs of the three animals. This appeared to indicate that relative reduction in length of the jaw was about equally attributable to diminished apposition at the condyle and diminished growth of alveolar bone.

Sections were made of the mandibles at various parts and examined histologically.

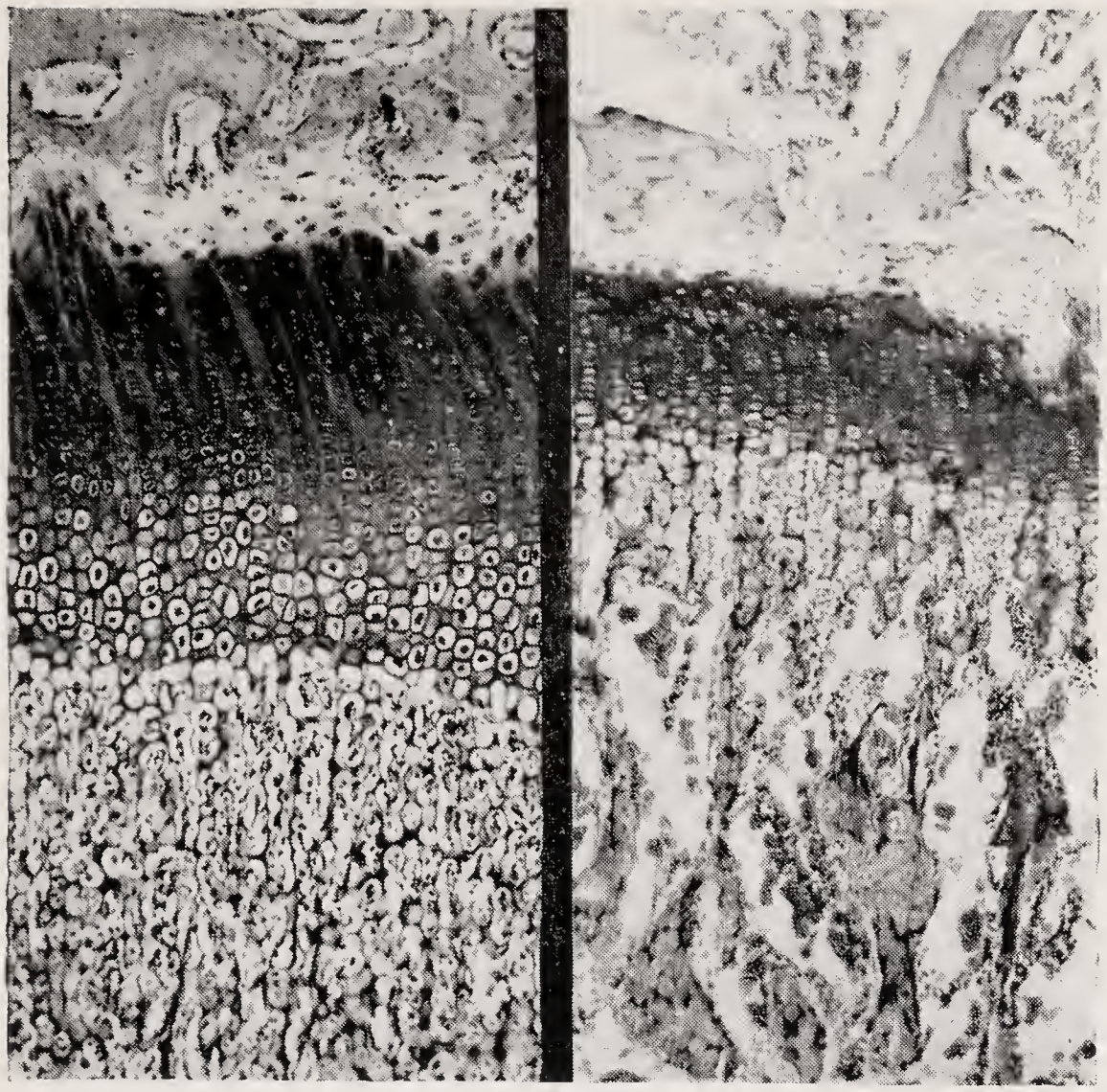
The mandibular condyle of the experimental animal compared with the controls showed changes comparable with those seen at the lower femoral epiphysis. The thickness of the condyle from the precartilaginous layer to the marrow was reduced to about half that found in the controls and notably at the expense of the layers of hypertrophic cartilage cells and of cartilaginous trabeculæ (*Fig.* 3). The primary bone trabeculæ were nearer to the cartilage and fewer in number. The difference between the condyle of the experimental animal and that of the controls was of the same kind (apart from the greater vascularity of the former) as the difference between the condyle of an adolescent and that of a baby.

Sections made in a coronal plane through the body of the mandible showed the appearance of greatly diminished activity of bone apposition along the outer side of the alveolar crest and relative decrease in height of the bone in the experimental animal in the permanent molar region. The external surface of the cortical bone in this animal was smooth and dense whereas in the controls it was composed of rapidly growing trabeculæ (*Fig.* 4).

There was no particular effect upon tooth formation or eruption in this short experiment, but there was a marked effect upon the spacing of the teeth, which were much closer together.

Fig. 2

From tracings of radiographs of half-skulls and mandibles. Experimental skull shaded.



Oestrogen injection: *first experiment. Lower femoral epiphysis: left control, right experimental animal.* × 55. *H. and E.*

Fig. 2

Mandibular condyles: *left control, right experimental.* × 90. *Van Gieson.*

Fig. 3

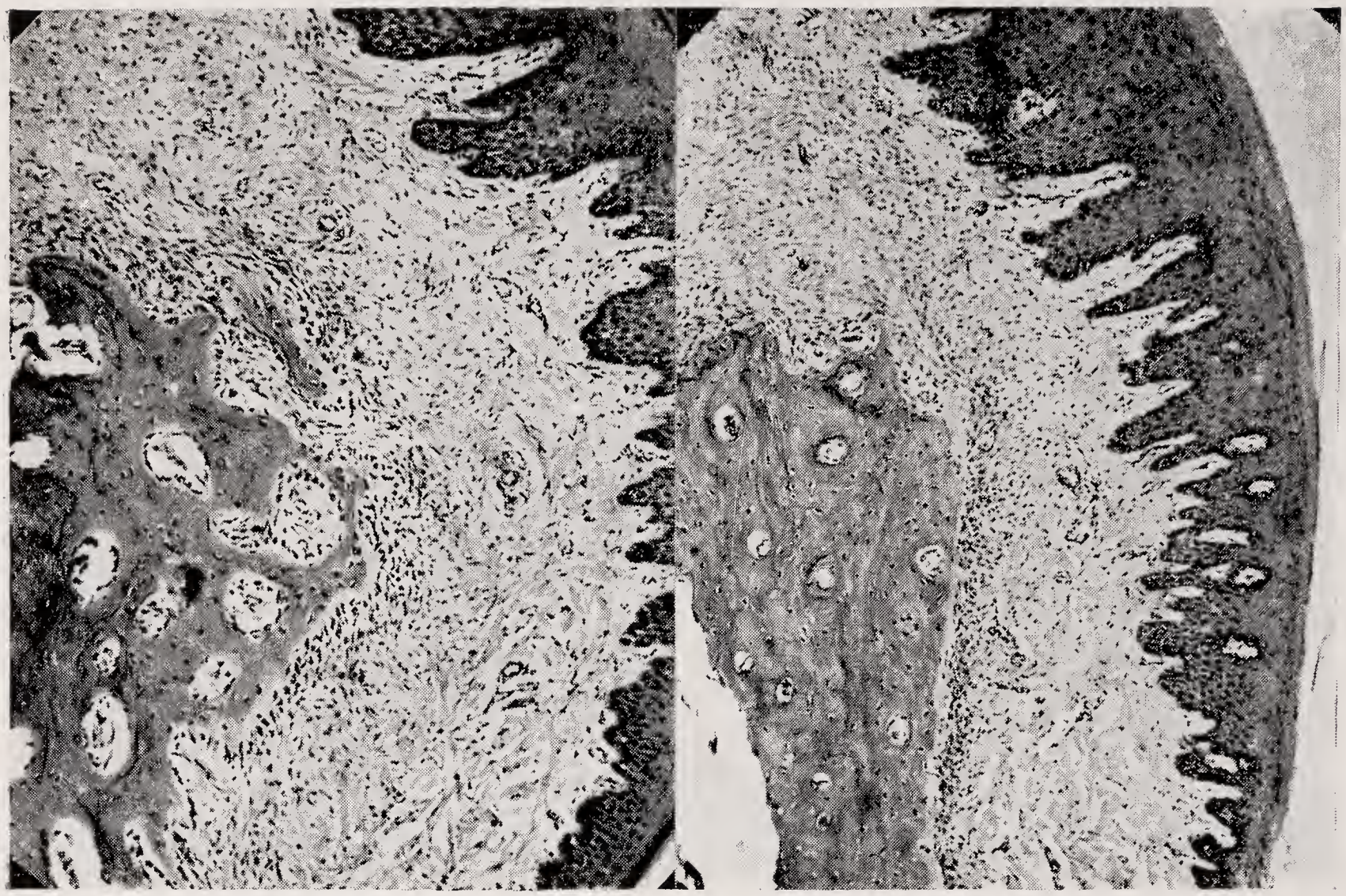


Fig. 4

Alveolar bone, crest of buccal plate opposite lower molar: left control, right experimental. × 90. *H. and E.*

To summarise the results of this experiment, the effects appear to have been greatly to retard growth at the epiphyseal plates of the long bones and also at the mandibular condyles and on the surfaces of the mandible and bones of the upper jaw. The effects upon the epiphyseal plates closely resembled those produced by œstrogens on mice by Sutro, and since similar effects were produced in the condyles of the kittens it is likely that they were specific. As the two jaws were proportionally retarded the other defects of jaw growth may well have been specific effects too, but it is possible that there was a merely toxic factor also since the dose was clearly a toxic one.

In order to confirm the casual relationship between the injection of œstrogens and the changes in the condyles, and to study other possible effects, a second experiment was performed in which half the dose was administered over a much longer period—from seven weeks to six months of age with a six weeks interval in the middle—540,000 i.b.u. being given in all. The experiment was so arranged that the final weights of the experimental and control animal (female litter-mates) were equal. The later closing epiphyseal plates such as that of the calcaneus were again narrower in the experimental animal (in the proportion of three to five) and had the appearance of less active growth, epiphyseal ossification being more advanced (*Fig.* 5).

The mandibular condyle again showed similar changes, the prechondral and chondral layers being thinner than those of the control in the proportion of two to three, and less evidence of erosion of calcified cartilage was seen (*Fig.* 6). There

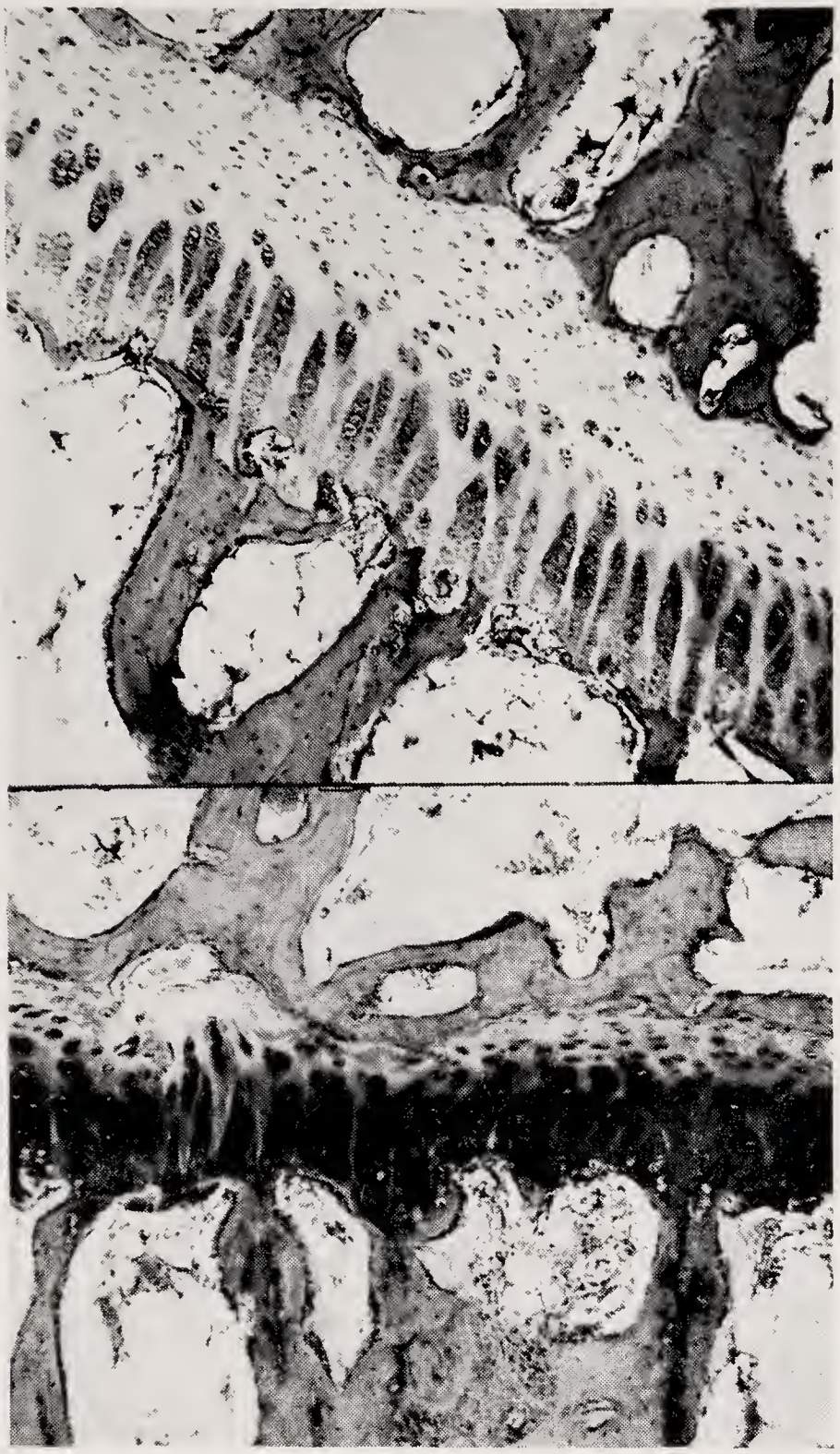


Fig. 5

Second experiment. Calcaneal epiphysis. *Control above, experimental animal below.* × 60. *H. and E.*

was also at the time the experiment was terminated much less active bone growth taking place on the surfaces of both jaws and at the sutures of the upper jaw in the experimental animal, though bone growth in connection with the eruption of teeth appeared active. A number of other differences between the experimental and control kittens may or may not have been due to the action of œstrogens: these include more advanced tooth eruption and a narrower upper dental arch in the experimental animal.

The experiments, then, appear to show that in the kitten œstrogens act upon the epiphyseal cartilages and mandibular condyles with similar effect in spite of the fact that growth at the former is by division and at the latter chiefly by apposition of chondrocytes ; and that the growth of the upper jaw is proportionally affected. If it is believed that in girls these hormones are concerned in the arrest of epiphyseal growth at puberty there is perhaps some increased probability that they also play a part in the arrest of antero-posterior growth of the mandible which takes place at the same period and with which a similar arrest of the upper jaw is allied. This is without any prejudice to the probability that a difference in reactivity of the tissues at puberty may also be concerned. The whole problem obviously needs fuller exploration than has been possible in this preliminary work.

From the orthodontic standpoint any

factor which limits the period in which compensation for previously retarded jaw development is possible or which may affect jaw growth and dental development differently is likely to be important.

I am indebted to Mr. J. E. Hutchinson, technical assistant in my department at Guy's Hospital, for the histological preparations and photomicrographs which illustrate this paper.

Fig. 6

Mandibular condyles :

Control above, experimental below. × 90. *H. and E.*

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DISCUSSION

Professor E. S. Friel, in proposing a vote of thanks to the President for his Address, said that he had greatly enjoyed it and that very few Presidential Addresses which he had heard had reached the standard of Professor Rushton's. The Address had added a great deal to the members' knowledge of the growth of the jaws and would doubtless, when it was published, give rise to a great deal of discussion on that subject.

Mr. Harold Chapman, in seconding the vote of thanks, said he was sure it would be supported by everyone present. He thought that the meeting was unique in the history of the Society, as on a previous occasion Professor Rushton's father had delivered the Presidential Address, and he did not recall any other case of a father and son having been President of the Society. He felt that Professor Rushton had helped the members very much on the subject of the growth of the jaw, especially in showing where the growth largely took place and that the length of the jaw should be regarded as being from the condyle to the chin, the back of the ascending ramus not being concerned in it.

The vote of thanks was accorded with acclamation, and, the President having thanked the members for the way in which they had received his Address, the meeting terminated.

* * * * *

TWO CASES OF LATE ORTHODONTIC TREATMENT

By E. K. BREAKSPEAR, L.D.S. (Eng.).

THE TWO CASES to be described illustrate the possibilities and limitations of late orthodontic treatment. Ideal results were neither expected nor attempted. The significant features of these cases are the age at which treatment was undertaken, the character of the results obtained and the effects observed on the parodontal tissues.

CASE I. (*Fig.* 1). The first case was undertaken at the age of 19. There has been some collapse of the lower arch following loss of $\overline{6}|$ and $|\overline{67}$, with close bite and crowding of the upper incisors. On the left side (*Fig.* 2) there is a somewhat post-normal canine relationship, and $|\overline{5}$ has been left behind in the forward growth of the lower jaw. It was however decided not to interfere with the condition on the left side of the mouth, beyond the extraction of $\underline{|8}$.

On the right side (*Fig.* 3) extraction of $\underline{6|}$ has nearly compensated for the loss of $\overline{6}|$, but $\underline{c|}$ has failed to move forward sufficiently and has only been partially absorbed, with the result that $\underline{3|}$ is impacted. In the lower arch, there has been a falling back of $\overline{3}|$ owing to lack of support. Treatment on this side was to extract $\underline{c|}$, move $\overline{3}|$ distally, followed by $\underline{2|}$ and $\underline{1|}$, and finally to stone the lower incisors and to retract and align the upper incisors as far as possible. At the same time $\overline{3}|$ was moved forward into correct relationship with $\underline{3|}$. Movement of $\underline{3|}$ was planned to take place at the rate of 0.4 mm. per week, measured at the contact points.

Active treatment occupied 15 months and retention was continued for 9 months. The final models were taken 12 months after removal of all apparatus. The incisor relationship has improved following the stoning of the lower incisors. There has been slight relapse of $\underline{1|1}$, but $\overline{3}|$ has remained in good relationship with $\underline{3|}$ in spite of the absence of support. This I consider to be the most remarkable feature of this case. When last seen, the parodontal condition was good.

CASE II. (*Fig.* 4). The second case was the brother of the preceding one, and was aged 24. Not only had all the first molars been lost, but $\overline{74}|$ as well. $\overline{8}|$ was tilted lingually 70 degrees from the vertical. Both upper third molars lay completely outside their opponents. $|\underline{4}$ was rotated and lying outside $|\overline{4}$, which was displaced lingually. There was a close bite incisor crowding and post-normal canine relationship, especially on the right side. Irregularity and traumatic occlusion had taken severe toll of the parodontal tissues, and extensive gingivectomies were carried out by Mr. Allan Thompson before and during treatment.

There seemed to be no hope of preserving the natural dentition unless orthodontic treatment was attempted. The unfavourable parodontal conditions made some kind of action imperative, and it was felt that there was little to be lost, but perhaps much to be gained by making the venture.

On the left side (*Fig.* 5) treatment was to bring $|\underline{8}$ into occlusion, rotate $|\underline{4}$ back into line and move $|\overline{4}$ buccally to retain it; to move $|\underline{3}$ distally, stone the lower incisors and retract and align the uppers. Active treatment occupied $2\frac{1}{2}$ years and retention was continued for another year. The final models were taken $3\frac{1}{2}$ years after all apparatus had been discarded.

They show that the movements on this side have been well retained on the whole. The canine relationship is good, and in spite of slight relapse the alignment of the upper incisors has improved. Although a bite plate was worn for a considerable time to facilitate alignment of the cheek teeth, there has been no permanent opening of the bite beyond what was

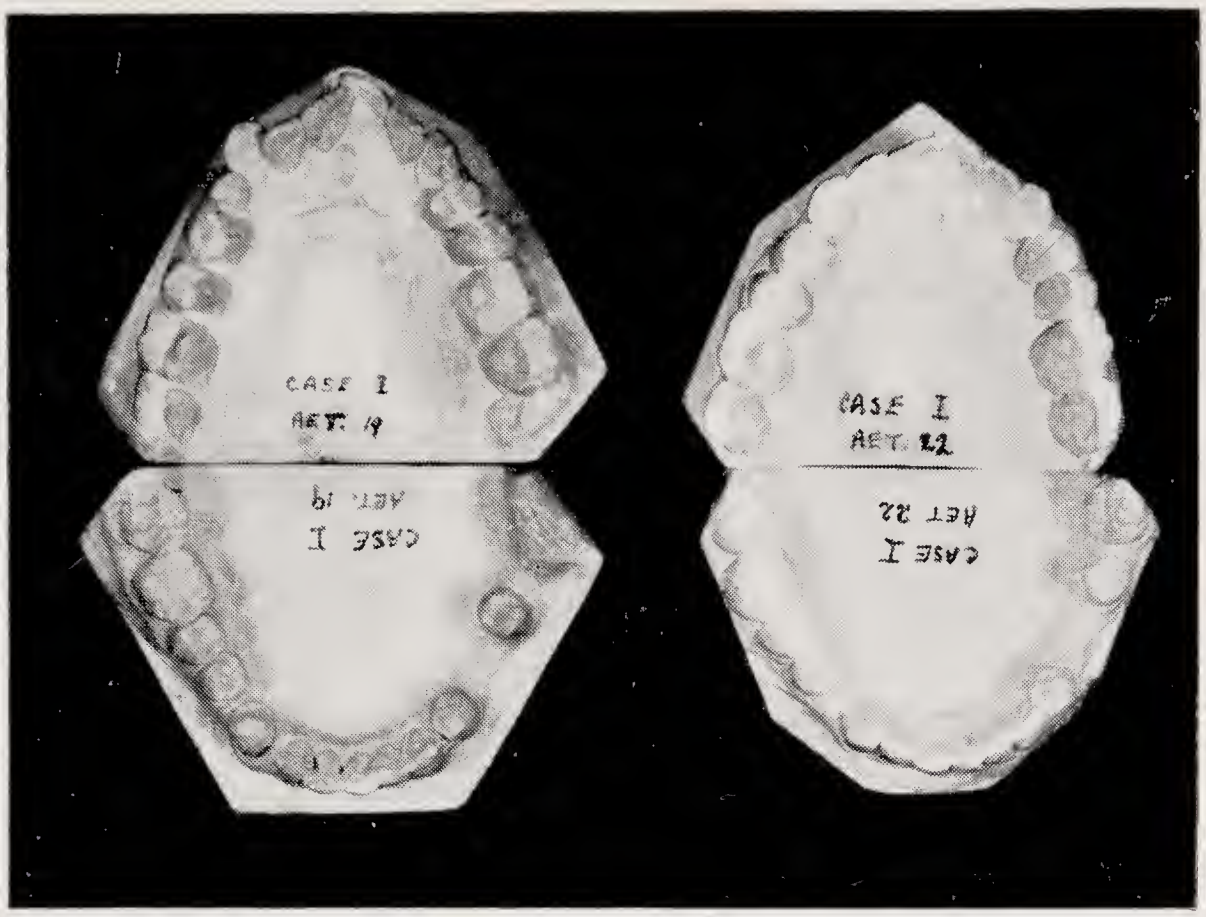

Fig. 1

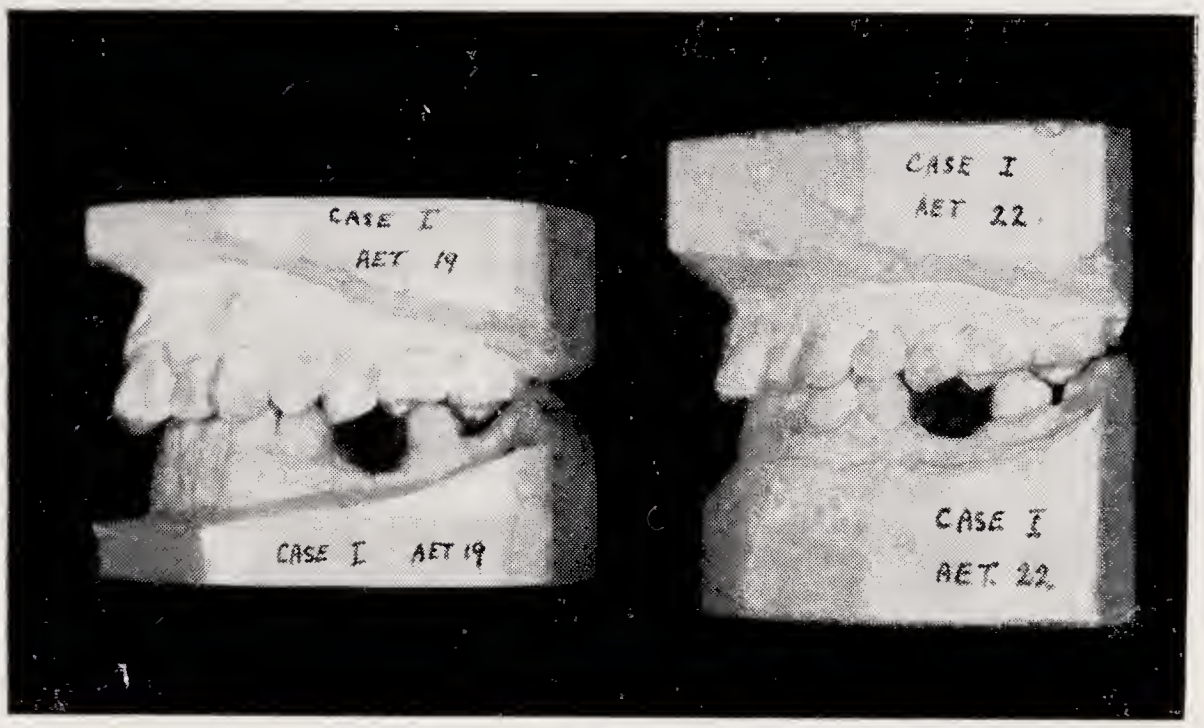

Fig. 2

Fig. 3

Fig. 4

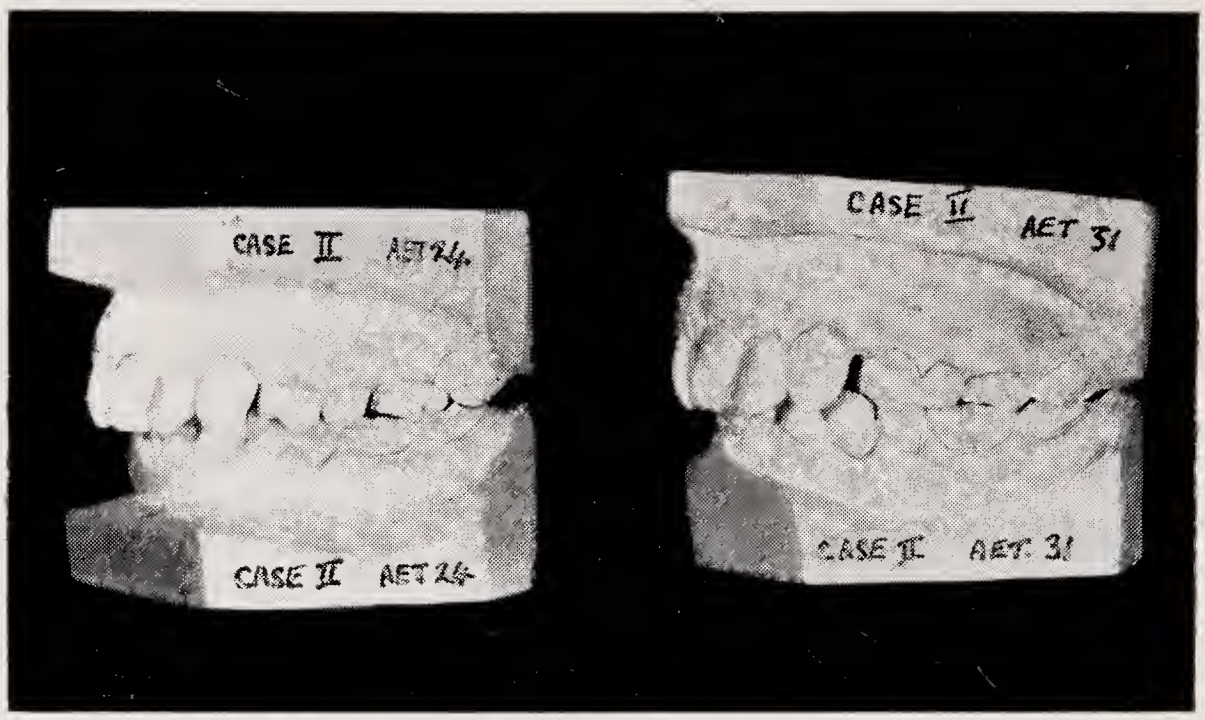

Fig. 5

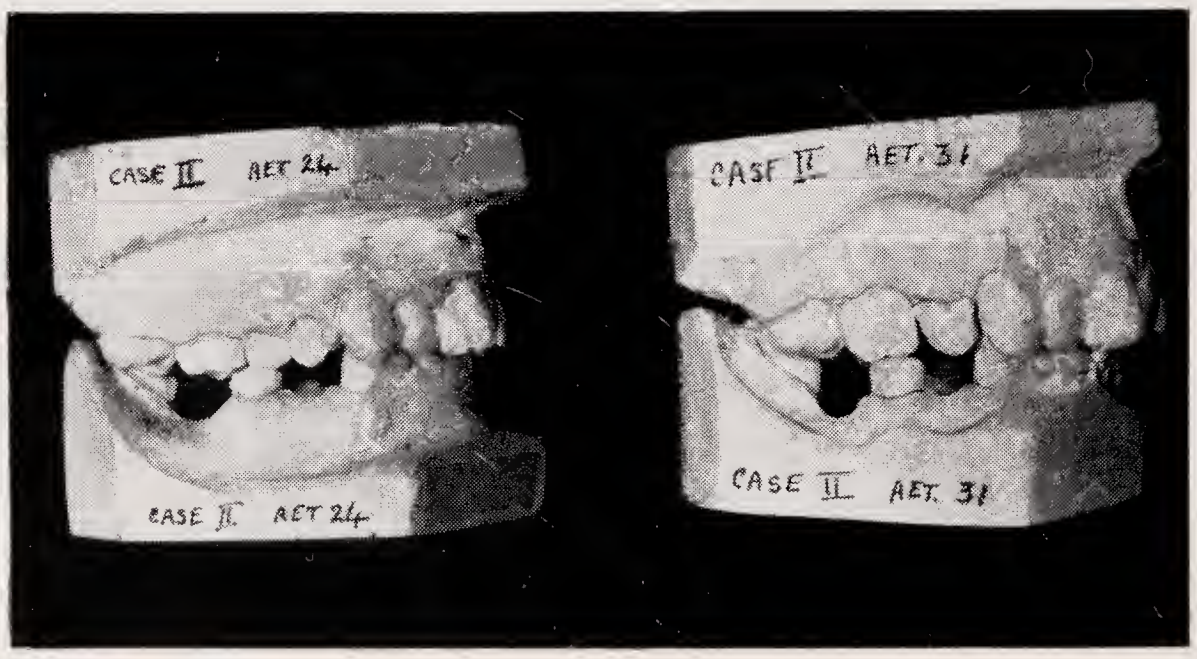

Fig. 6

obtained by stoning the lower incisors. There has been slight relapse of $\underline{|8}$ but it is still substantially in occlusion. The rotated $\underline{|4}$ is in good relationship with $\overline{|4}$.

Now for the parodontal effects. It might be supposed that in a mouth already predisposed to parodontal disease the teeth most affected would be those which had been moved by apparatus, but this has not proved to be the case. A colleague who did not know which teeth had been moved adjudicated upon them, and of the three which he judged to be in least satisfactory parodontal condition, only one was a tooth which had been subjected to planned movement. This was the $\overline{|4}$ which had been moved buccally. This tooth had caused some concern, as its movement had taken place more rapidly than was planned, and some looseness was apparent at the time. Slow movement is essential in these cases. It is possible, however, that traumatic occlusion is also a factor here, as the tooth is now somewhat buccal to the line of the arch.

The second tooth in unsatisfactory parodontal condition was $\underline{|7}$ which was an anchorage tooth. I think it is important to remember that anchorage teeth are held comparatively rigidly, and if a small reciprocal movement occurs they may be held for a long period in a position which subjects them to unnatural occlusal stresses, with perhaps a band or clasp acting as an unwanted fulcrum. This may have occurred here.

On the right side (*Fig.* 6) treatment was to extract $\underline{4|}$, move $\underline{3|}$ distally, align upper incisors as much as possible, and bring upper and lower wisdom teeth into occlusion. This was carried out as planned, with the exception of the correction of the lingually tilted $\overline{8|}$: after several unsuccessful attempts this part of the plan was abandoned. The chief difficulty was the impossibility of obtaining sufficient clearance for movement to take place, even when a bite plate was worn.

As the final models show, failure to bring $\overline{8|}$ into occlusion has resulted in relapse of $\underline{8|}$, which had been brought into line but had nothing to keep it there. There has also been some relapse of $\underline{3|}$, partly owing to a swing of the mandible to the right, which has made it more difficult to achieve a good canine relationship on this side. $\underline{875|}$ have drifted forward into the space left by extraction of $\underline{4|}$, and this has allowed $\overline{8|}$ to rise under tongue pressure to an angle of 45 degrees from the vertical. Parodontally, however, it has resulted in increased masticatory stress being transmitted through the isolated $\overline{5|}$ to $\underline{7|}$, which, deprived of the support of $\underline{4|}$, has become somewhat loose in consequence. This was the third tooth judged by my colleague to be in an unsatisfactory condition, and it is worth noting that this too was an anchorage tooth.

It is, however, encouraging to record that the parodontal condition of most of the teeth which had been moved was described by my colleague as satisfactory. This seems to show that tooth movement in adults can be safely carried out within certain limits, provided such movement is carried out slowly and with due regard to the natural forces which will be operative when apparatus is finally discarded. It also appears that traumatic occlusion, particularly in anchorage teeth, is a far more serious danger than tooth movement as such.

In this connection it is interesting to ask why the lingually tilted $\overline{8|}$, which one would have expected to show signs of severe occlusal trauma, is in fact in relatively good parodontal condition (*Fig.* 7).

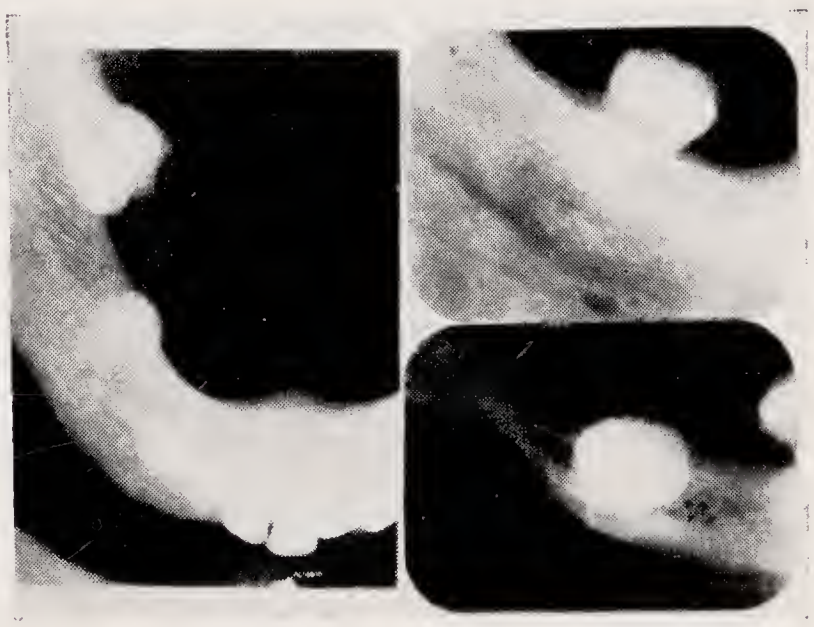

Fig. 7

For years this tooth has borne a masticatory stress on its buccal surface, and the X-rays show that the root is normal in form, i.e., inclined at an angle of 45 degrees from the vertical. I should be interested to hear explanations of its apparent immunity in a mouth which is otherwise particularly susceptible to parodontal lesions.

In conclusion, I should like to extend my particular thanks to Mr. R. Ernest Rix for his advice and encouragement in the treatment of these cases, to Mr. Allan Thompson for his help and interest on the parodontal side, and to Mr. J. E. Mayes of the Dental Photographic Department, Guy's Hospital, for the preparation of the photographs and slides.

* * * * *

DISCUSSION

The President said he was sure the members were very grateful to Mr. Breakspear for his interesting communication, which involved several difficult problems with regard to the relation of trauma and mechanical forces in periodontal disease.

Mr. Allan Thompson said that he had seen over a period of years the cases described by Mr. Breakspear and considered them to be of considerable importance. He thought Mr. Breakspear would agree with him that there was a certain degree of periodontal deterioration. It seemed to him that periodontal disease and orthodontics were so closely related that, as a preventive line of treatment for periodontal disease, early orthodontics was of extreme importance. The cases shown by Mr. Breakspear illustrated the connection between periodontal disease and orthodontics, and one could only wish that they had been treated earlier.

* * * * *

SOME BASES FOR ÆTIOLOGY AND DIAGNOSIS IN ORTHODONTICS

By C. F. BALLARD, L.R.C.P., M.R.C.S., L.D.S.

LAST NOVEMBER I told you that I believed that the skeletal pattern is genetically determined and cannot be altered by orthodontic treatment. I admitted this was a rather dogmatic statement, but to-night I hope you will permit me to bring to your notice some observations that support that view.

Before going further, I should like to quote Thompson and Brodie from their paper *Factors in The Position of the Mandible.* Their conclusions were :—

" (1) The form and proportions of the human mandible are determined at a very early age, and once established, do not change.

" (2) The position of the mandible in relation to the rest of the neck is an integral part of the pattern of the individual and is just as changeable as form. The presence or absence of teeth has little, if any, bearing on the form of the mandible exclusive of the alveolar process.

(3) The presence of absence or teeth has little, if any, bearing on the rest position of the mandible, which is always such that the teeth are out of occlusion to a greater or lesser degree.

(4) The proportions of the face as a whole, as far as height is concerned, are constant throughout life. If the mandible is carried by artificial restorations to a rest position beyond that of physiologic rest, it will return to its preordained position through an accommodation of the alveolar process or abutment teeth."

I quite agree with these views and further believe that there is a physiological vertical occlusal position for each individual. This may be alterable within the free way space, but scientific investigation is necessary before any definite statement can be made. I hope also tonight to suggest to you that the degree of incisor overlap, or so-called close bite, should not be related to vertical height but is entirely the result of the relationship of these teeth to one another, except in those cases in which they are prevented from coming into any sort of occlusion by muscle action, i.e. habits with tongue, lip, finger, thumb, etc., or by skeletal deformities.

If my contentions are correct I must show you how it is possible to produce normal antero-posterior relationship of the arches without altering the antero-posterior relationship of the mandible to maxilla, and how it is possible to alter incisor overlap without increasing or decreasing the vertical height. To find the answers to such problems I began some years ago to note clinically the axial inclinations of the maxillary incisor teeth to the horizontal or Frankfurt plane and of the mandibular incisors to the mandibular plane. The mandibular plane, as you know, is the plane used by Tweed and others, which passes through the two most dependent points of the lower border of the mandible. Clinical observation was very unscientific but I had no facilities for lateral radiographs or photographs at that time. I did, however, come to certain conclusions which have been strengthened by the results of treatment based on them and by the few lateral radiographs which I have been fortunate to obtain more recently. Most of these lateral radiographs were, unfortunately, not taken on orthodontic patients but in Mr. Gwynne-Evan's E.N.T. Clinic.

Analysis of the Normal

I must now give you the assumed normals on which preliminary diagnosis and treatment have been made. Firstly, the maxillary incisors have been related to the Frankfort or horizontal plane, and œsthetically they appear to be at their correct axial inclination when they are in a degree of proclination of about 105° to this plane. The lower incisors have been

related to the mandibular plane. Margolis and others have worked out this angle and their general conclusion is that it should be within 5° either side of the right angle to the mandibular plane (*Fig.* 1). We could now define normal incisor relationship as when, with the upper incisors at their correct angle to the Frankfort plane and with the lower incisors at their correct angle to the mandibular plane, they occlude so that the overlap is about one third of the labial surface of the lower incisor. But let us examine this in greater detail. You will see from a lateral tracing (*Fig.* 2) of a normal occlusion that when these angles are about correct, the incisal edge of the lower incisor meets the lingual surface of the upper incisor at about its middle third. In this position there must be a very delicate balance of forces produced by four factors.

(1) By the inherent tendency of the lower incisors to continue vertical development, probably not so great in the upper incisors.

(2) The postural position of the lips exerting a force on the labial surfaces of the upper incisors and, to a lesser extent, on the lower.

(3) The pressure exerted by the tongue at rest and during speech, mastication, swallowing, etc.

(4) Occlusal stresses during mastication.

What is more important, however, is that the long axes of the lower incisors appear to be almost at right angles to the lingual surfaces of the upper incisors. When they are in this position, vertical development alone cannot influence incisor overlap. The relationship of the incisal edge of the lower incisor to the lingual surface of the upper incisor must change to permit an increased or decreased overlap. An investigation of many hundreds of normal occlusions might show that the average angle between the long axis of the lower and upper incisors is about 130° and that the lingual surface of the upper incisors is about 18° to its long axis. This means that the long axis of the lower incisor is at an average angle of 130° minus 18° equals 112° to the lingual surface of the upper incisor.

There is another important variable which influences incisor relationship and that is the Mandibular to Frankfort plane angle. This must obviously be so as we are relating the upper incisors to the Frankfort plane and the lower incisors to the mandibular plane (*Fig.* 3). Tweed, in discussing this angle, summarised as follows :—

" (1) In cases that fall within the Frankfort-Mandibular plane range of 16°—28° the prognosis varies from excellent for that nearest the 16° extreme, to good for those nearest the 28° extreme.

(2) In cases that fall within the Frankfort mandibular plane angle range of 28°—32° prognosis will vary from good at 28° to fair at 32°. In cases that fall within the Frankfort Mandibular plane angle range of 32°—35° the prognosis is fair at 32° and not favourable at 35°.

(3) In cases that fall within the Frankfort-Mandibular plane angle range of 35° upwards the prognosis is not favourable at 35° and virtually nil at extremes of 45°—55°."

In a footnote he states, add 5°—7° if measurements are made on lateral radiographs.

I accept these statements with many reservations and believe that a lot more investigations are needed. It seems to me that Tweed tends to base his results on the æsthetic appearance of the incisors and lips, avoiding any suggestion of prognathism, rather than on what we regard as normal incisor overlap for a functionally correct bite (*Fig.* 4). I would regard many of his end results, judging from his illustration, as having a double retroclination and a very excessive incisor overlap. However, I do agree that over a certain angle, perhaps about 38°, the skeletal pattern might be a deformity rather than a variation, making prognosis for treatment bad.

But returning to the incisors, we are now in a position to state what must be the anterio-posteror relationship of the incisor apical bases to permit of the correct axial alignment of the teeth so that they occlude with the correct degree of

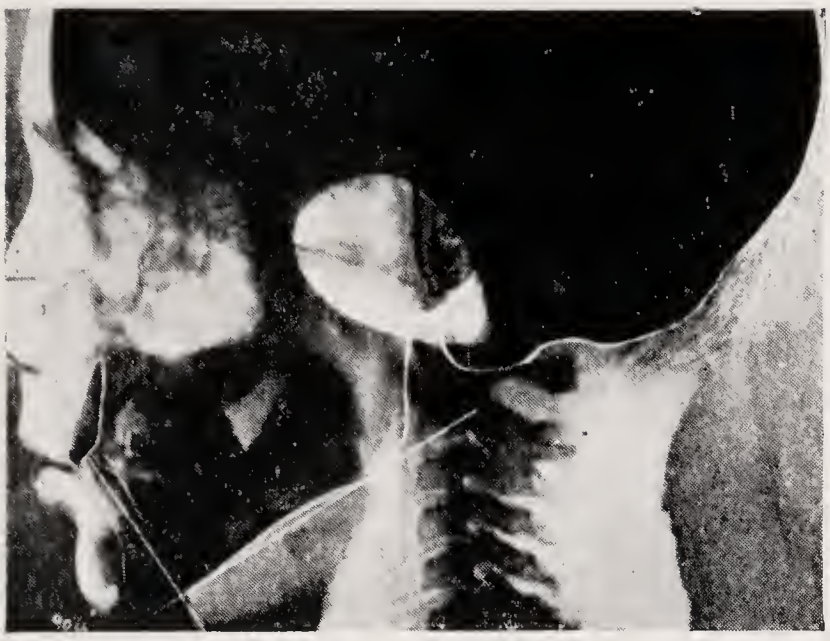

Fig. 1

From Margolis. Shows lower incisors at 90.5 degrees to the Mandibular Plane.

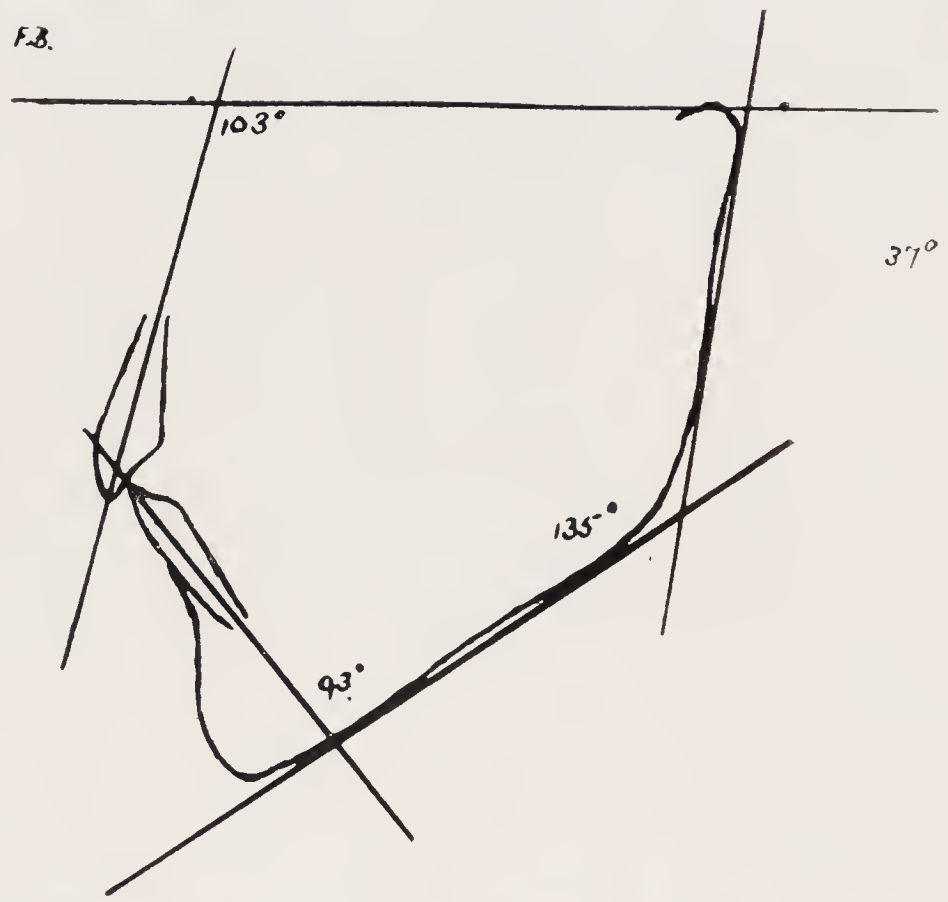

Fig. 2

Lateral tracing with normal occlusion and normal skeletal pattern. Skeletal Class I.

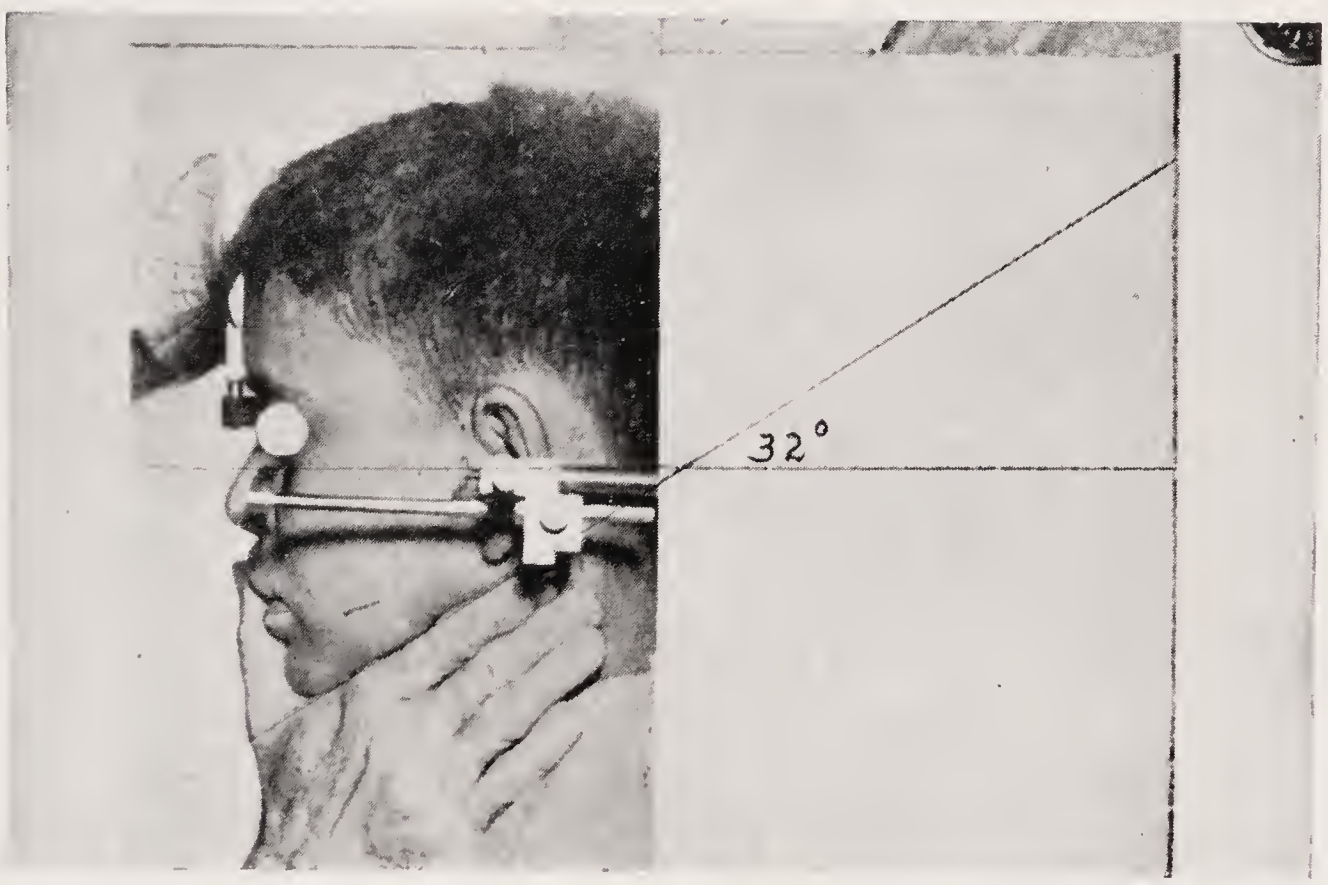

Fig. 3

From Tweed.

Fig. 16.—This case was treated and the full complement of teeth retained with the results seen in the middle figure. Note the poor facial aesthetics. The case failed and two years later all four first premolars were removed and the case was retreated. Facial aesthetics are greatly improved and the denture is stable.

Fig. 4
From Tweed.

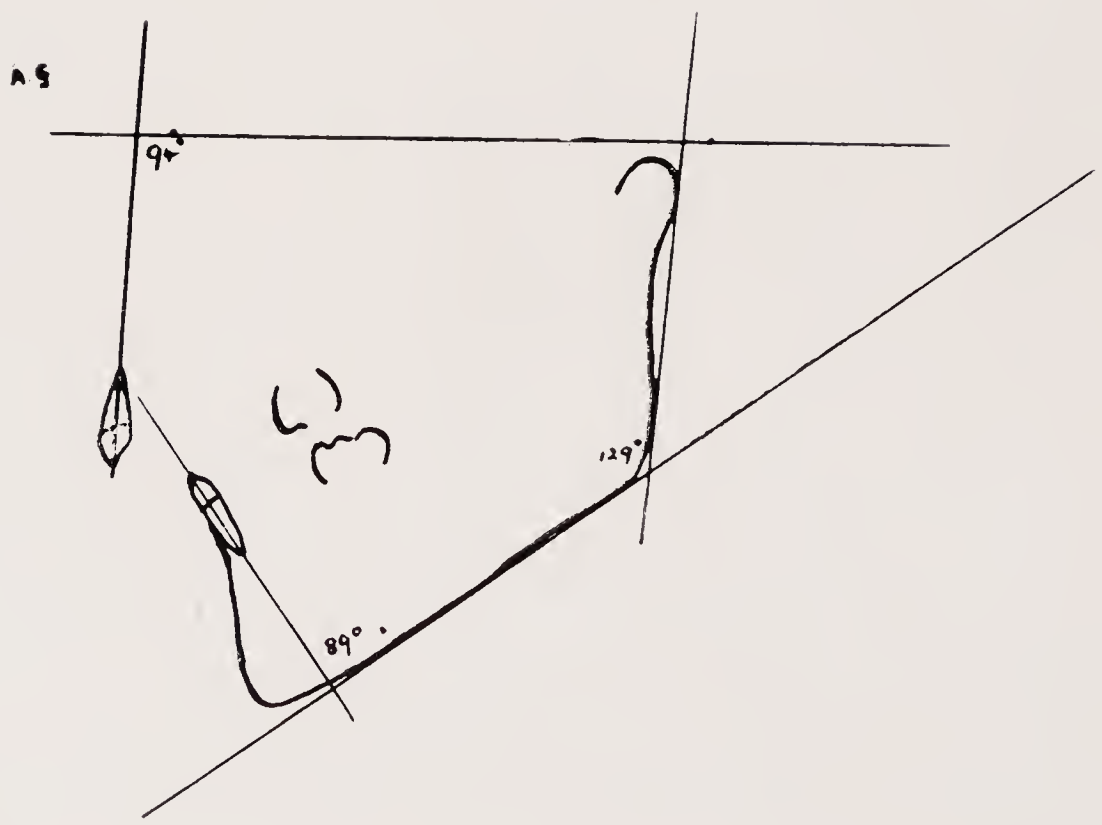

Fig. 5
Skeletal Class II. Occlusal Class II in deciduous dentition. Prognosis bad.

overlap. I would suggest it is as follows :— when, with the upper incisors within the average variation of angulation to the Frankfort plane and with the lower incisors within the average variation of angulation to the mandibular plane, the incisal edge of the lower incisors meet the lingual surfaces of the upper incisors so that there is about one third overlap.

I said last November that I thought that, not only was the skeletal pattern genetically determined, but the relationship of the dento-alveolar structures to basal bone was likewise genetically determined. It follows then from our definition of normal incisor apical base relationship that, in these circumstances, the mandible has its correct antero-posterior relationship to the maxilla for the establishment of what we regard as normal occlusion. There are three possible antero-posterior relationships of mandibular apical to maxillary apical base. The normal has been defined and may be called Class 1. Class 2 relationship can then be defined as when the mandibular apical base is posterior to the maxillary apical base. *Fig.* 10 and 15 illustrate a Class II skeletal pattern. Although I used the tracing in *Fig.* 10 to demonstrate the retroclination of lower incisors and proclination of upper incisors in Class II. Div. 1 occlusion, *Fig.* 15 shows that when treated, the upper incisor had to be relatively retroclinated to 98° to the Frankfort plane with the lower incisors at 91.5° to Mandibular plane. I would regard this as a compromise from the correct axial inclination necessitated by the mandibular apical base being behind the maxillary apical base, i.e., Skeletal Class II. *Fig.* 5 shows an extreme skeletal Class 2 with a deciduous dentition. As the apical base relationship cannot be altered, prognosis for treatment is bad and if any incisor relationship is established, it will be by excessive proclination of lower incisors or retroclination of the upper incisors of doubtful stability. Note that from Tweed's Classification, prognosis is not bad in this case. Class III apical base relationship may be defined as when the mandibular apical base is anterior to the maxillary apical base so that incisor relationship is only obtained by excessive retroclination of the lower incisors or, and less likely, by excessive proclination of the upper incisors (*Figs.* 6 *and* 7). This is the classification we have used at the Royal Dental Hospital by clinical observation only, but our end results of treatment have, in most cases, confirmed our diagnosis. There are two important things to remember about it, however. It is not an attempt to relate apical bases to profile, so when we say the mandible is posterior to maxilla it may be that æsthetically the maxilla is at fault, but because we cannot alter these genetically determined factors it does not alter our diagnosis or treatment. If the skeletal pattern must be changed for æsthetic reasons, then that is work for the plastic surgeon. The second important point to bear in mind is that apical base relationship does not determine occlusal relationship. It is not uncommon to have Class III apical base relationship with a Class II Div. 1 occlusal relationship.

Aetology of Abnormal

Now, correlating my observations with these normals and abnormals, consider the question of excessive overlap of incisors. In my view, this is nearly always the result of abnormal relationship of the incisors to one another which may be produced in two ways :—

(1) By abnormal axial inclinations of upper or lower incisors, or both, but on normally related apical bases.

(2) By normal or abnormal axial inclinations of incisors on abnormally related apical bases.

The first group may be illustrated by the following common examples :—

(1) The close bite following early loss of deciduous teeth, which is nearly always the result of the lower incisors retroclinating, i.e., changing their axial inclination to the mandibular plane. The incisal edges drop lingually from the lingual surfaces of the upper incisors. This disturbs their functional vertical relationship and the former elongate to establish contact with something, perhaps the neck of the upper incisor or the palate.

(2) The close bite associated with proclination of the upper incisors due to abnormal posture of the upper lip.

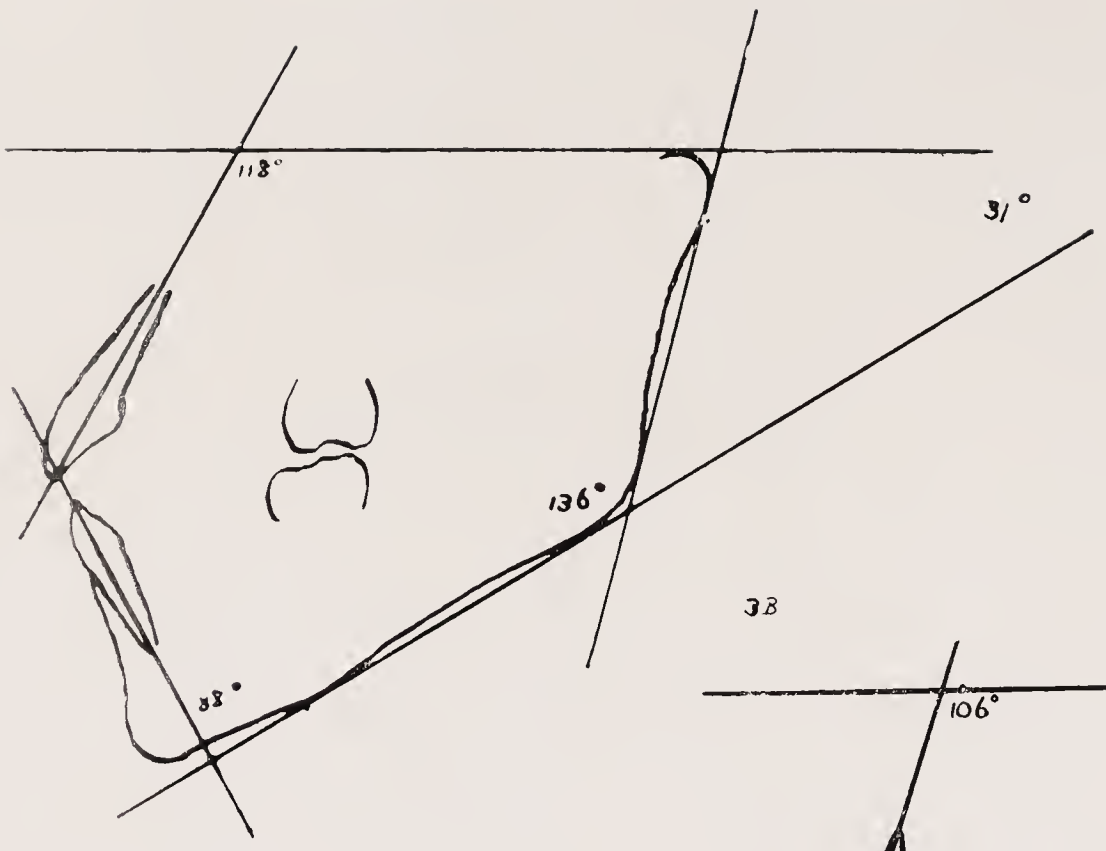

Fig. 6
Skeletal Class III.
Occlusal Class I.

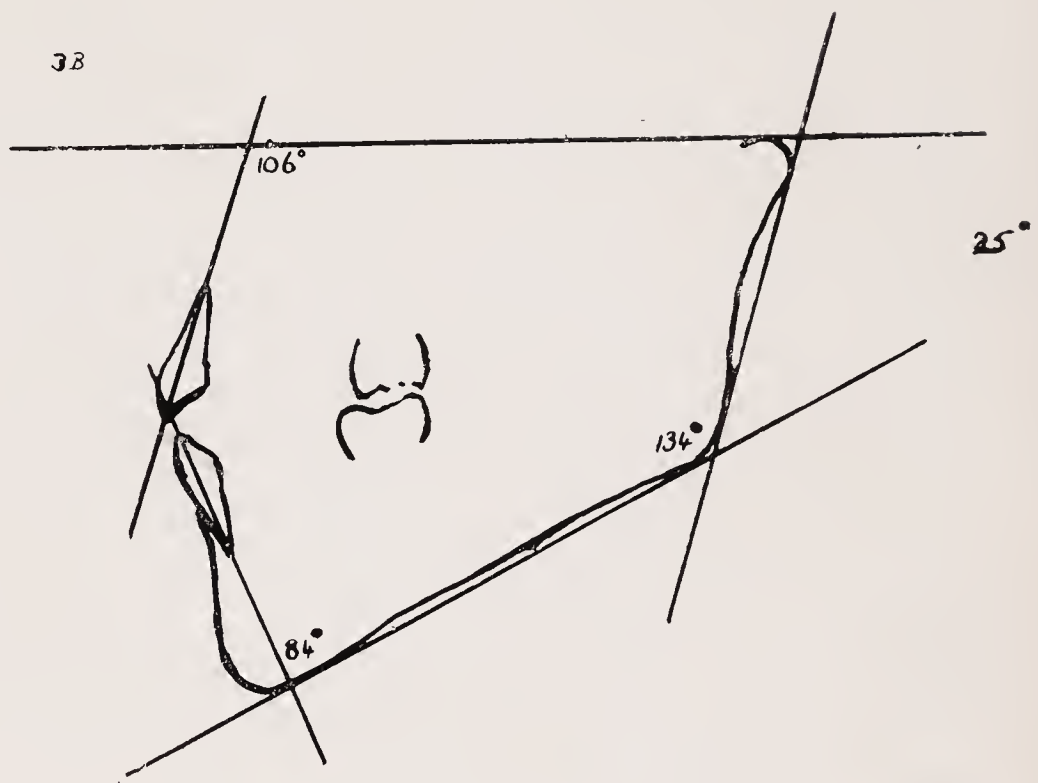

Fig. 7
Skeletal Class III.
Occlusal Class I.

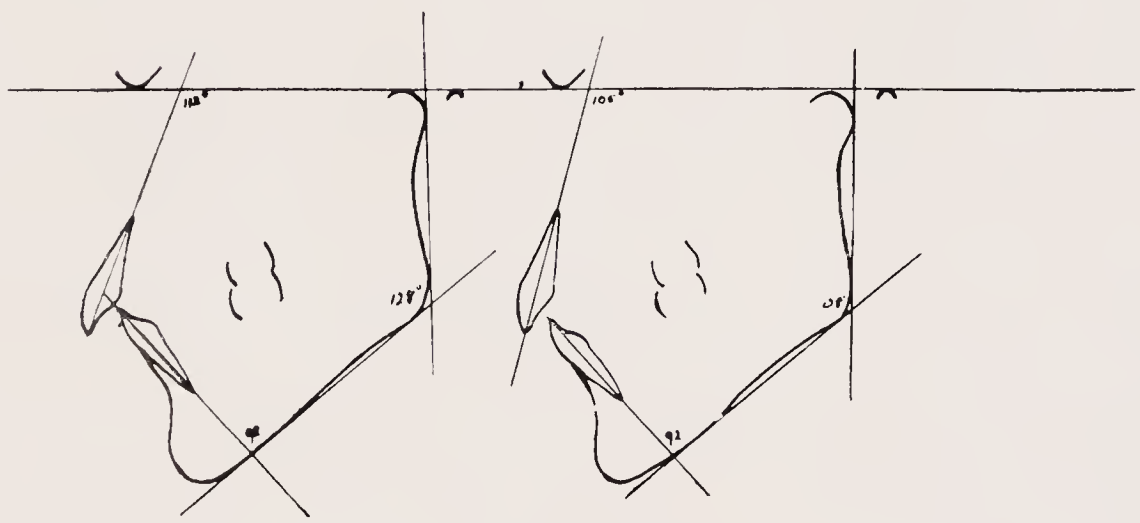

Fig. 8
Shows change in axial inclination when proclinated after incisors are retracted and resultant reduction in overbite.

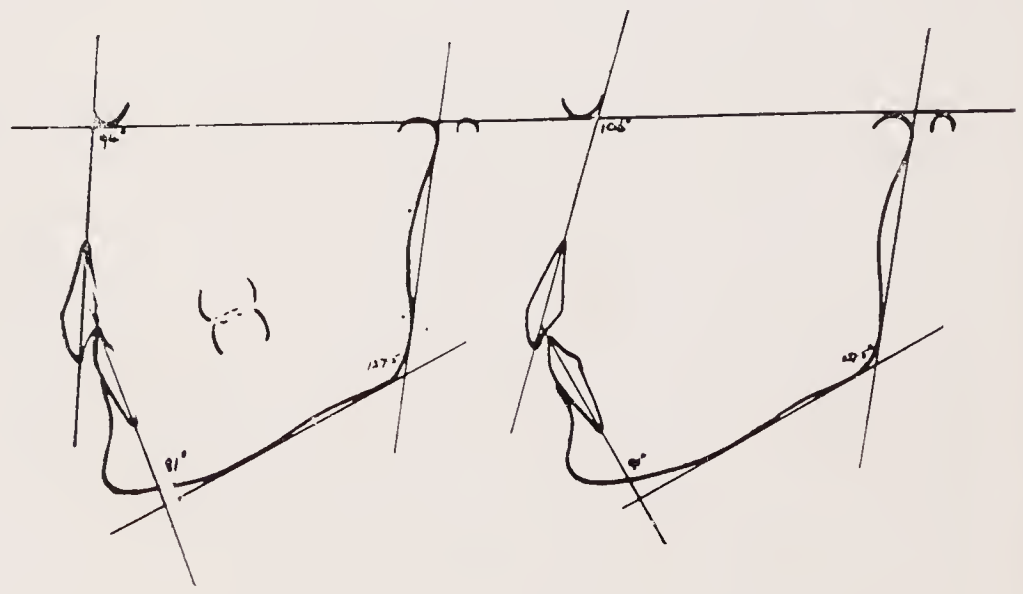

Fig. 9
Shows Occlusal Class II div. II incisor relationship and the changes of axial inclination required to correct the excessive overbite. This incisor relationship frequently results from early loss of lower deciduous molars.

The upper incisors change their axial inclination to the Frankfort plane (*Fig.* 8).

(3) The close bite of the type associated with the Class II. Div. 2 Angle's occlusal relationship in which both upper and lower incisors are usually retroclinated (*Fig.* 9). Failure to correct this change of axial inclination would inevitably result in a permanent close bite which is accentuated if, say, the $\overline{4}\,|\,4$ are extracted to relieve crowding following loss of deciduous teeth.

The obvious inference from these observations is that a bite plane is not the correct treatment, but appliances which will correct the abnormal axial inclinations. The second group will be fully explained when I deal with antero-posterior abnormalities in the relation of apical bases.

The next step in my argument is to relate our observations on axial inclinations of incisors to buccal segment position and our diagnosis of apical base relationship to the more scientific diagnosis of antero-posterior abnormalities of occlusion, i.e. Angle's Class 2 and Class 3 cases. As I have already said, I have been convinced for some years that my successful treatments in antero-posterior abnormalities have not been the result of skeletal change and my observations confirmed that view. (*Fig.* 10). Last Novemebr I showed this slide saying that it was probably a typical Class 2 Div.. 1. occlusal abnormality. The points to note are that the lower incisors are retroclinated and the upper incisors proclinated. Now if the buccal segments have not been mutilated and are in continuous contact point relationship, then the mandibular buccal segments must be too far back, an amount relative to the retroclination, and the maxillary buccal segments too far forward in a similar way. I am certain that this is the true explanation of most Class 2. Div. 1 occlusal abnormalities.

In Angle's Class II Div. 2 occlusal abnormalities, we see a difference of axial inclination between the maxillary central incisors and the maxillary canines. If there is a normal apical base relationship then the lower incisors are retroclinated and the buccal segments relatively are placed too far distally to the maxillary dentition. The maxillary central incisors are retroclinated to the retroclination of the lower incisors, producing the typical close bite which I have already illustrated. The maxillary buccal segments, however, are frequently placed too far forward as indicated by the forward tilt of the canines. When we are confronted with a Class II occlusal abnormality therefore, our diagnosis of skeletal pattern should be to assess, from the axial inclination of the incisor teeth, whether we are in actual fact dealing with a skeletal abnormality at all. This assessment will be made much more easily when we are in the habit of examining lateral radiographs of all our cases. We have been attempting it clinically at the Royal Dental Hospital for the past three years and our results on the whole have confirmed our original diagnosis (*Fig.* 11).

This table shows a clinical analysis of 135 cases being treated by Mr. Hooper at the Royal Dental Hospital. When a more

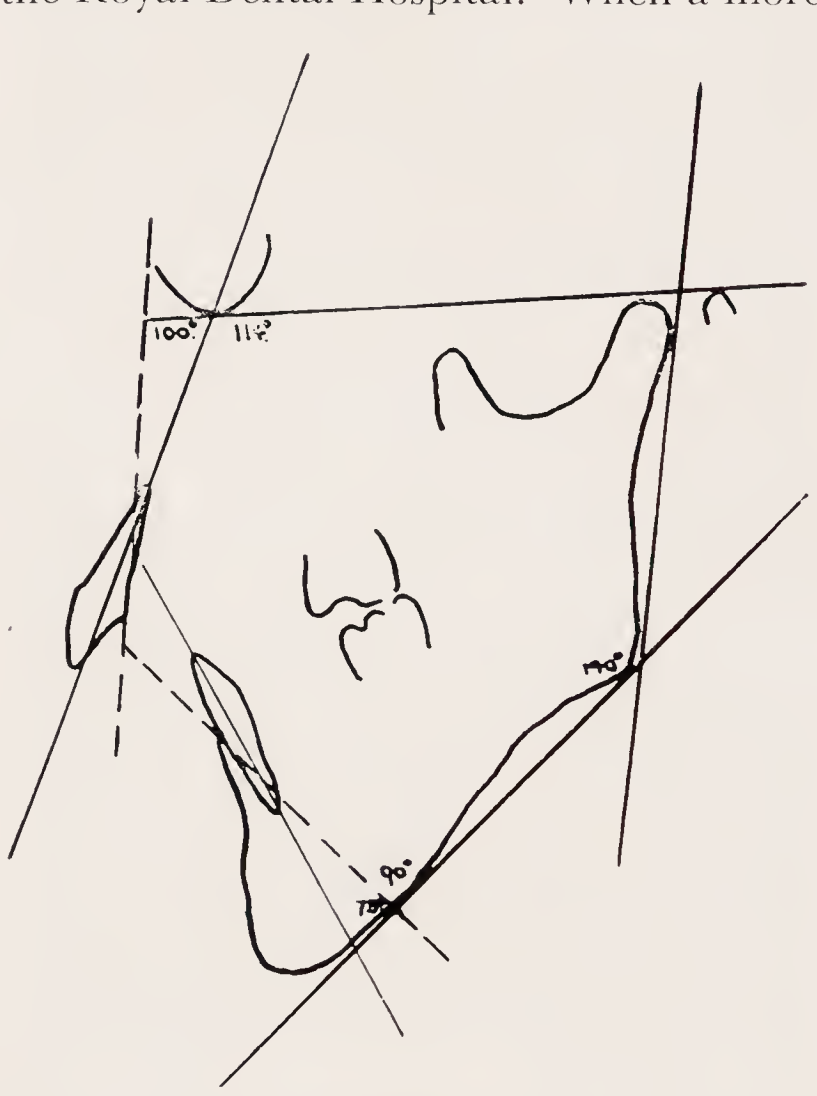

Fig. 10

Mild Class II skeletal pattern. Class II div. I occlusion. Shows proclination of upper incisors and retroclination of lower incisors.

Occlusal Class	Skeletal Class 1	2	3	
I	6	0	24	30
II Div. I.	25	9	8	42
II Div. II. ..	6	2	0	8
Class II Intermediate	7	2	21	30
III			25	25
Total	44	13	78	135

Fig. 11

accurate diagnosis can be made by lateral radiographs there may be considerable variation, but all the same they reveal some interesting points.

You will note that true inferior re-trusions or skeletal Class II cases are comparatively uncommon and skeletal Class 3 predominate. From the æsthetic and evolutionary point of view, does this mean that the maxilla is becoming reduced in size at a greater rate than the mandible? I believe there is much evidence to support this view.

The importance of correct assessment of apical base relationship is, of course, that firstly, knowing what change of axial inclination of incisors and movement of buccal segments is required, our treatment can be arranged accordingly. Secondly, it has great value in assessing prognosis. A Class 2 occlusion on a Class 2 apical base relationship has a very poor prognosis, particularly if associated with a Frankfort mandibular plane angle of over about 38°. A Class 3 apical base relationship with a Class 2 occlusion, not so very uncommon, has a fair prognosis for a good æsthetic result but with the incisor relationship being imperfect.

As for the Angle Class 3 occlusion, these are almost invariably associated with a skeletal Class 3 pattern, and if any incisor relationship is obtained it is always by a compromise from the normal axial inclination ; that is usually by excessive retroclination of the lower incisors, sometimes by excessive proclination of the upper incisors and sometimes by both these variations (*Fig.* 12 *and* 13). Incisor overlap in such skeletal patterns is very variable, from the extreme of lingual occlusion of upper incisors to the " close bite " of the previous case (*Fig.* 14).

In a previous paper I said that, in my conception of the positioning of the teeth in the oral cavity, the factors concerned may be resolved into four groups. They are as follows :— (1) *Skeletal pattern*, (2) *Muscle pattern*, (3) *Dento-alveolar factors*, (4) *Occlusal forces*. I then discussed briefly the important part that muscle patterning and maturation played in orthodontics. So far to-night, I have given you my conception of a basis for a diagnosis of skeletal pattern and now I will deal briefly with the third and fourth factors before attempting to correlate all four to a rationale of diagnosis and treatment.

Irregularities within the dento-alveolar structure not associated with either an abnormal muscle pattern or an abnormal dental apical base relationship are usually the result of the dental base being too small for the dentition. This may manifest itself in two directions, antero-posteriorly in the buccal segments or laterally in the

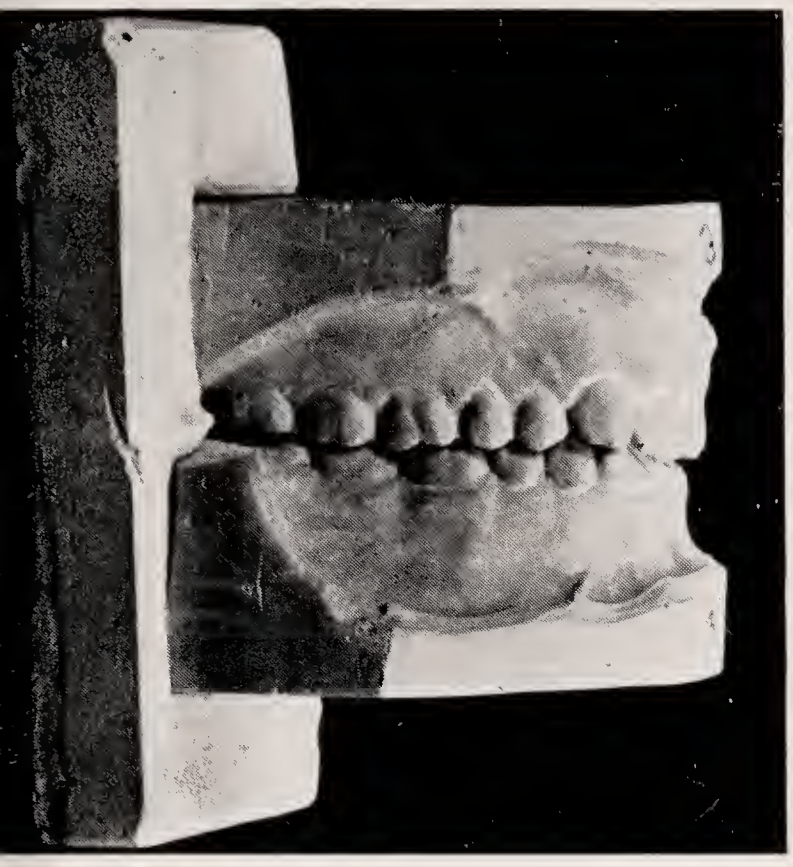

Fig. 12

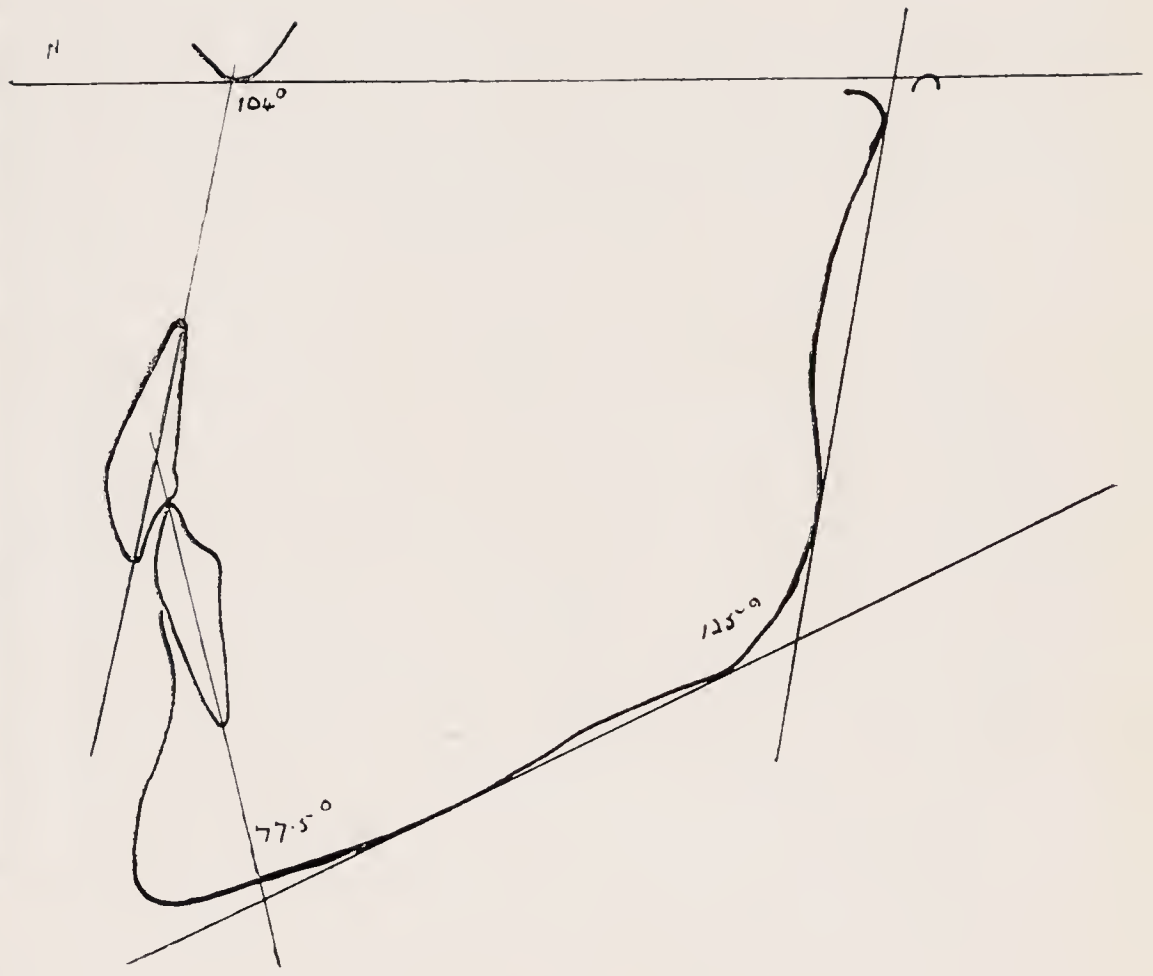

Fig. 13

Figs. 12 and 13. Show excessive overbite associated with Class III skeletal pattern. Class I occlusion. Frankfort-Mandibular Plane Angle 25°.

labial segments. In the buccal segments the forward tilt of the canine as demonstrated in typical Class 2. Div. 1 and 2 occlusal abnormalities is, in my opinion, diagnostic of antero-posterior crowding, the anterior teeth having been pushed mesially by those developing behind. A common manifestation of the same thing is, of course, the forward movement of teeth after early loss. I quite agree with Tweed that in such cases the discrepancy between tooth substance and size of dental base must be corrected by extraction, but I do not agree that it should be the four first premolars in most cases.

As regards occlusion, Mr. Softley dealt very fully and satisfactorily with the vertical relationship of the dentitions in his paper last December. There is one point, however, which I must mention and that is the forward component of occlusion stressed by some writers. It might be an explanation of the retroclination of lower incisors after early loss of deciduous or permanent teeth from the buccal segments. An alternative theory is that the position of equilibrium of muscle forces has been disturbed because the tongue now has to fill gaps in the buccal segments.

Treatment

Now to correlate the four factors and indicate treatment. If the teeth are in a position of equilibrium within muscle forces then they can be moved in the line of the arch without risk of relapse, or alternatively, they can be moved across the line of the arch if an abnormal muscle action has been demonstrated and if one of the objects of treatment will be to re-educate the muscle pattern. The abnormal swallow associated with a contracted maxillary arch as described by Mr. Rix is an excellent example of such an abnormality and I am certain that there are many more connected with variations of tongue posture. The incisors then cannot be tilted antero-posteriorly without a change of muscle pattern being necessary for stability, and the buccal segments similarly cannot be tilted laterally without a change of muscle pattern being required. An important point is that unless an abnormal muscle action is demonstrated, lateral expansion is bound to relapse.

In Class 2 and Class 3 occlusal abnormalities, therefore, the correction of incisor relationship requires a re-education of muscle posture in most cases, but the

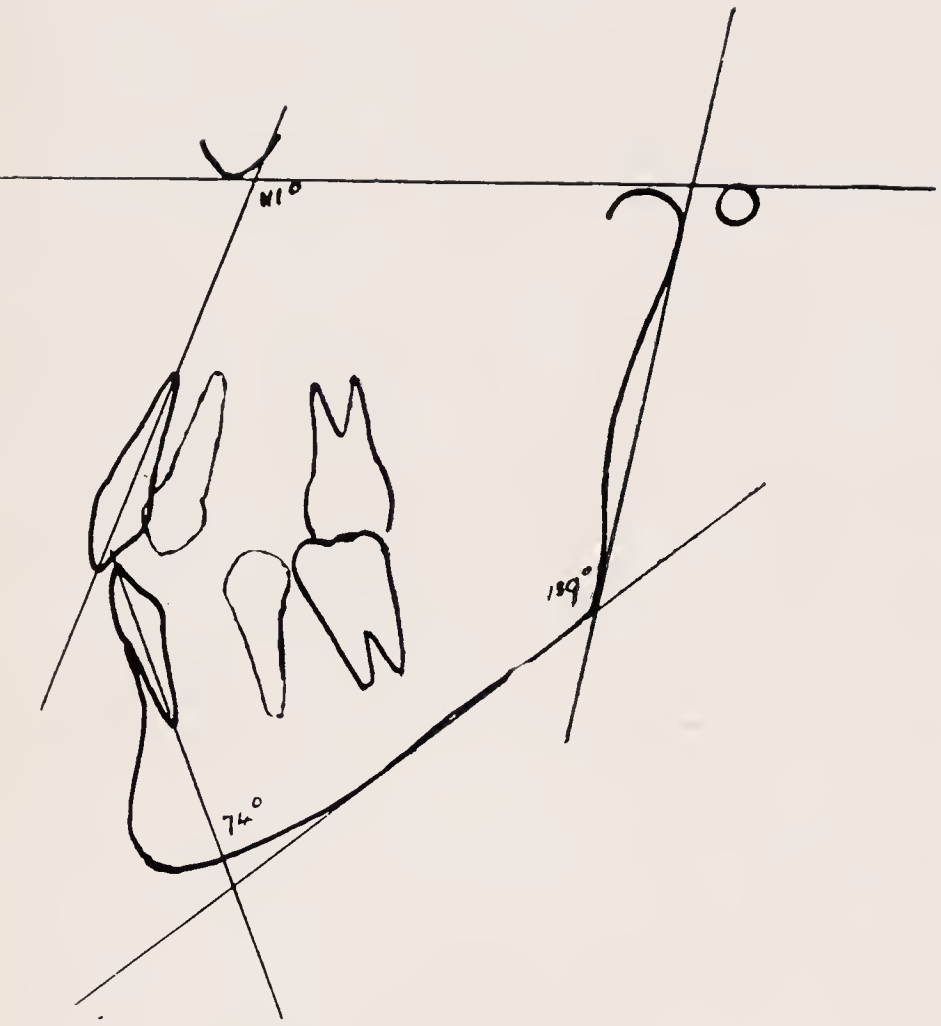

Fig. 14

Skeletal Class III. Occlusal Class I. Frankfort-Mandibular Plane angle 36°.

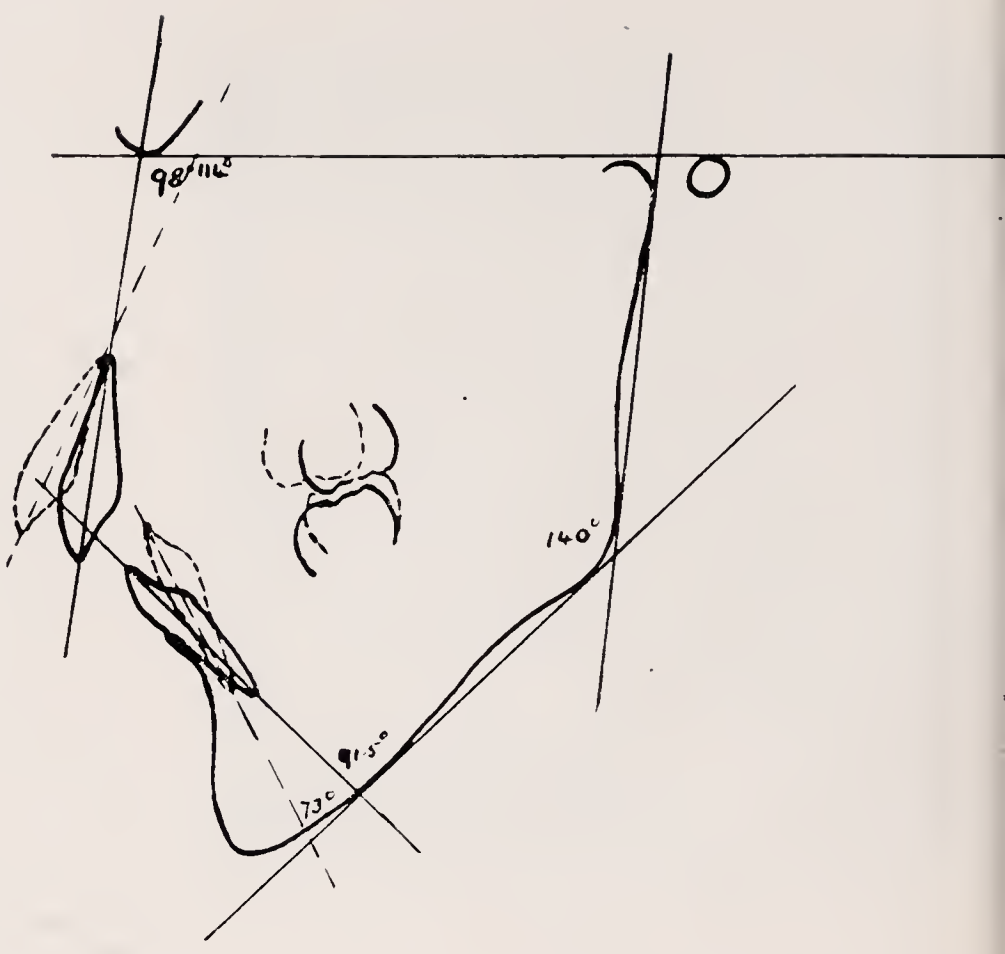

Fig. 15

Shows the change of axial inclination and correction of molar relationship when Class II div. I occlusion is treated. Mild skeletal Class II therefore upper incisors are retroclinated in the result.

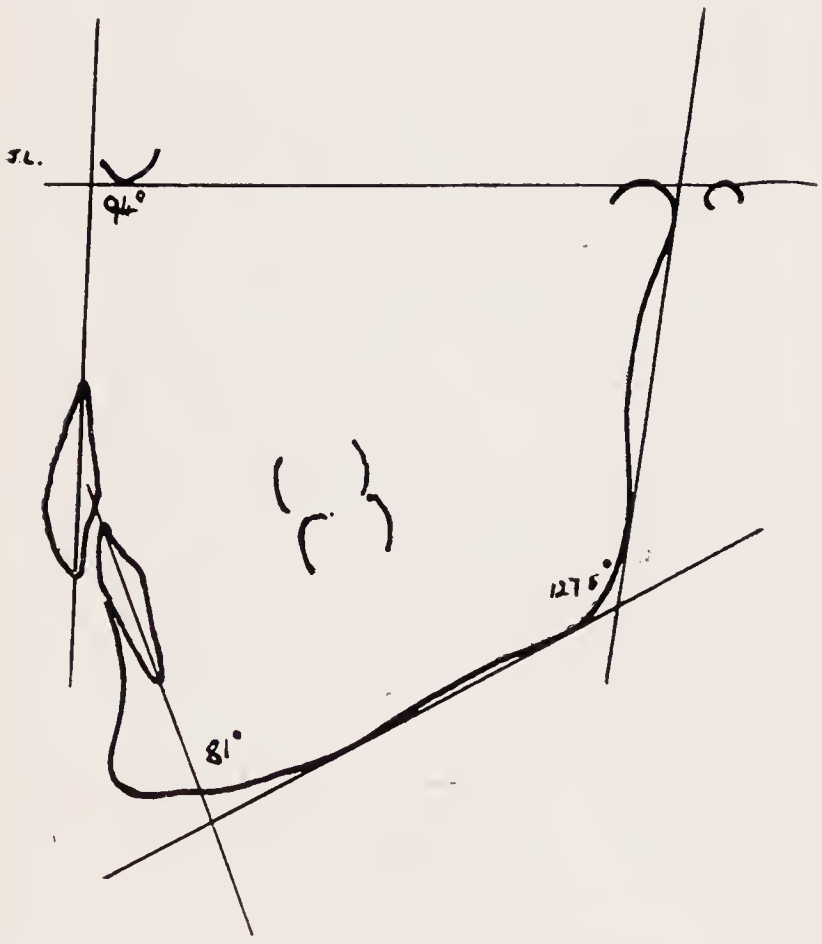

Fig. 16

Shows the typical abnormalities of axial inclination in Occlusal Class I div. II.

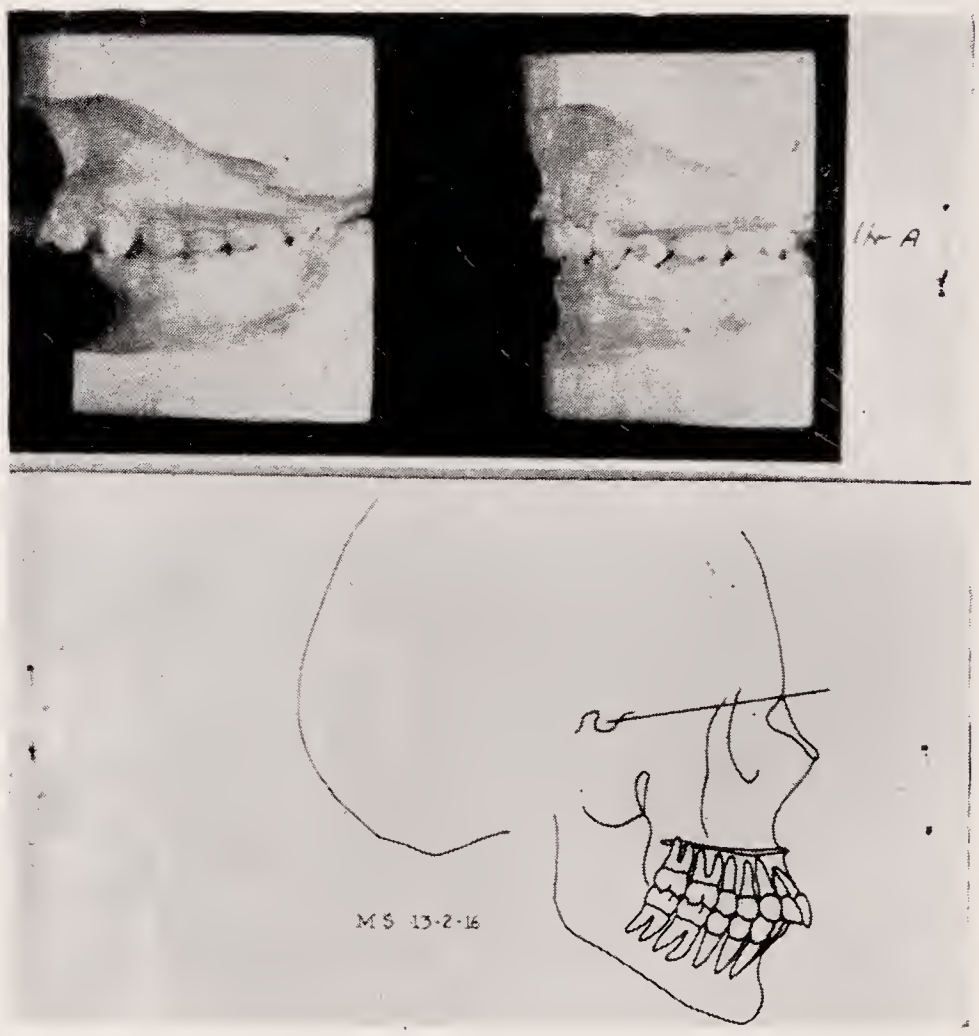

Fig. 17

From Allen G. Brodie.

movement of the buccal segments is along the line of the arch within the equilibrium of muscle forces.

Fig. 15 shows superimposed tracings before and after treatment of Class 2 Div. 1 occlusion. Before treatment, this boy's upper incisors were proclinated and his lower incisors retroclinated, these teeth being in a position of equilibrium in an abnormal muscle posture. There is excessive overlap of incisors produced, as I have previously demonstrated, by the abnormal relationship. The postnormal occlusion is produced by his maxillary buccal segments having moved mesially (probably only a tilt) so that they have remained in contact with his proclinated incisors and canines and the reverse in the mandible, i.e. the mandibular buccal segments are too far distally an amount relative to the retroclination of his incisors. The treatment which has been used for such cases at the Royal Dental Hospital for the last few years is simple intermaxillary traction. This moves the maxillary buccal segments distally and corrects the proclination of the upper incisors, and brings the mandibular buccal segments mesially tilting the incisors labially. The change of axial inclination of the upper and lower incisors establishes normal overlap if the skeletal pattern is within normal limits of variation and the antero-posterior movement of the buccal segments produces normal occlusion. Tweed, quoting Brodie, says that the buccal segments will not move distally. I do not agree with this, if the teeth have moved forward because of a short dental base relative to tooth substance, then if this is corrected by extraction, they will move distally in most cases. In such cases I prefer to remove $\frac{7 \mid 7}{}$ if $\frac{8 \mid 8}{}$ are present because this keeps the most important part of the buccal segment intact and also permits the use of the reciprocal action of intermaxillary traction to correct the retroclination of the lower incisors. The removal of $\frac{4 \mid 4}{}$ does not permit of this adjustment. Having established normal occlusion it only remains to see that the abnormal lip posture is either correcting itself because of the new position of the teeth or is re-educated. You will have noticed that I have not mentioned expansion and so-called "raising the bite"; much time is wasted performing these operations quite uselessly.

In Class 2 Div. 2 occlusal abnormalities, because as a rule the upper and lower incisors are retroclinated (*Fig.* 16) but in a position of equilibrium in muscle forces and because, as already mentioned, the maxillary buccal segments as shown by the canine are in different axial inclination to the incisors, then in treatment normal occlusion is established chiefly by a backward movement of the maxillary buccal segments. The lip action prevents correction of incisal axial inclination and therefore prevents the correction of the excessive incisor overlap. In my experience, if in such cases the upper incisors are pushed labially, there is almost inevitably relapse. I suggest that one of the great advantages of intermaxillary traction is that, although there is a reciprocal pull between maxillary and mandibular dentition, lip action is one of the factors which determines the degree of forward movement of the mandibular dentition and backward movement of the maxillary dentition, so making for a more stable result.

Before summarizing, I must bring to your notice what I believe is a quite genuine and typical difference between the Class 2 Div. 1 occlusal abnormality seen in this country and that which Tweed and others in America call typical. I have said that our cases have a retroclination of the lower incisors and proclination of the upper incisors, probably more of the latter than the former. Tweed and others, however, are always referring to a double proclination.

Fig. 17 is an illustration from Allan G. Brodie's paper "Does Scientific Investigation Support the Extraction of Teeth in Orthodontic Therapy?". He was discussing extraction in treatment and was not necessarily agreeing with this treatment. It serves to show, however, the typical double proclination. Calculating as well as possible from the lateral tracing I should say that the upper incisors are at about 120° to the Frankfort Plane and

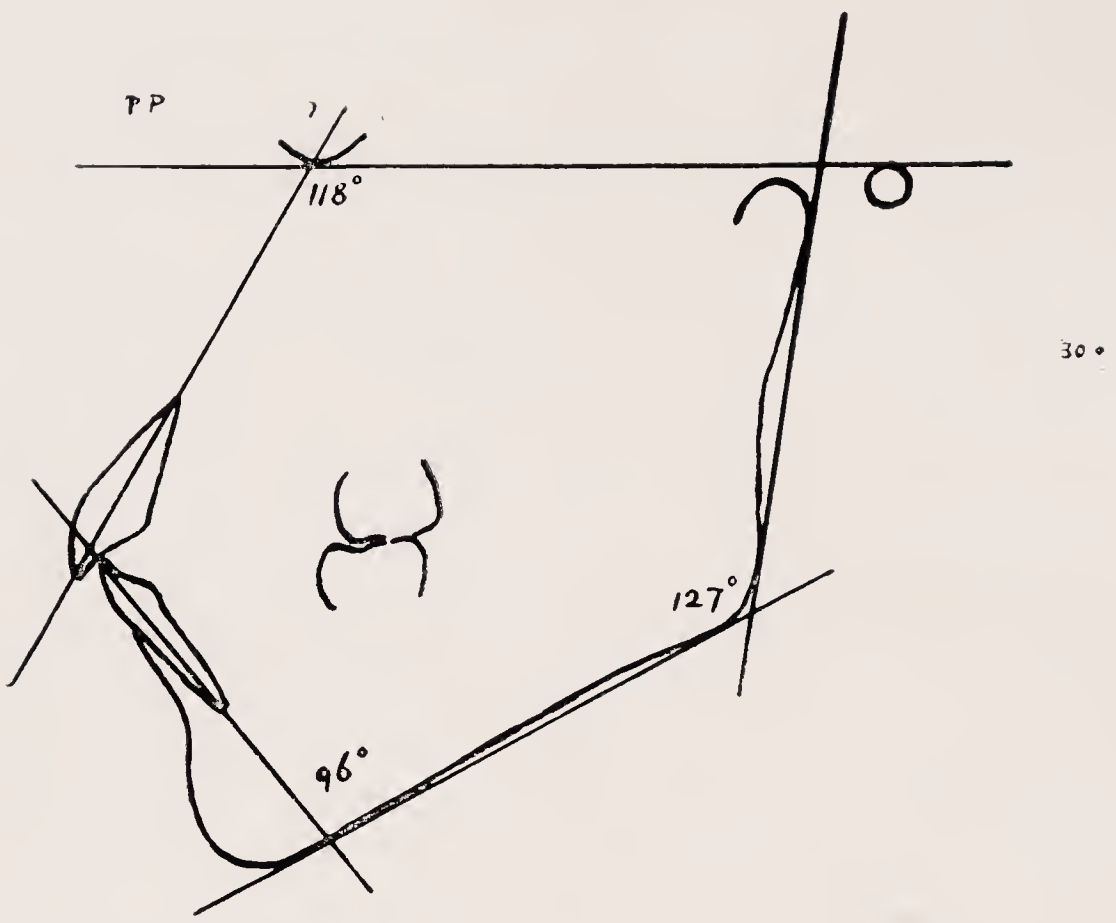

Fig. 18
Occlusal and skeletal Class I with double proclination.

the lower incisors at about 98° to the Mandibular Plane. The models show the occlusion before and after treatment by the removal of four first premolars.

We see a small percentage of these cases at the Royal Dental Hospital and the interesting thing is that they are almost invariably of central or southern European origin. The answer may be that the Americans have a greater admixture of central and southern European types than we have.

Fig. 18 shows the typical double proclination of the apparently prognathic Italian type and it may be this characteristic which produces Tweed's Class 2. Div. 1.

Prognosis

I think we are in a position to say that good prognosis depends on the following :-

(1) That the Mandibular-Frankfort plane angle as described by Tweed is within normal limits, remembering that at least 7° should be added to his figures if the calculations are made on lateral radiographs.

(2) That the dental base relationship is such that the incisor occlusion can be brought within the normal, merely be altering the axial inclinations.

(3) That an abnormal muscle action or posture can be corrected after the teeth have been aligned.

(4) That the tooth substance size has been adjusted to the size of the dental bases.

May I conclude firstly with the hope that in the near future many of us will be assessing our cases and checking our treatment with accurate lateral radiographs. Secondly by expressing my thanks to Mr. Hovell and Mr. Hooper at the Royal Dental Hospital for their helpful criticism and suggestions, and also their help in carrying out these lines of treatment on a large number of cases.

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DISCUSSION

The President said that Mr. Ballard had given a remarkably detailed analysis, which was obviously the result of prolonged original work, and the paper bristled with points for discussion.

He understood Mr. Ballard to say that the genetic pattern was not altered by orthodontic treatment, and he was a little surprised at that. If it was a fact, he thought it was because orthodontists had not yet found the way to alter the genetic pattern, not because the genetic pattern could not be altered by environmental changes. It had been shown, for instance, that the skull measurements of children born to foreign immigrants in America differed from the skull measurements of children of the same race in their native country, and other similar instances could be quoted. Did Mr. Ballard think that orthodontists did not see their patients young enough, that by the time they saw them the children's genetic pattern had been so firmly moulded by their particular environment in this country that nothing could be done to alter it ?

Mr. K. E. Pringle said that the impression he had gained during his recent visit to the United States was that, on the whole, the material there was not the same as that in this country and differed from it in exactly the way that Mr. Ballard had described.

Miss L. M. Clinch said that she was very interested in the paper. She was glad to hear Mr. Ballard say that he had no proof of the theory that he had put forward, and certainly from clinical observation she did not agree with that theory. She thought that Mr. Ballard was too pessimistic. He seemed to reduce orthodontics to moving teeth about or altering the inclination of teeth. That might be so in the case of adults, but she did not think it was so with children.

Mr. Ballard took as one of his hypotheses the statement that the form and proportions of the human mandible were determined at a very early age and, once established, did not change. She did not know that there was any proof that they did not change, and the President had just said that they did change. Again, what did Mr. Ballard mean by " a very early age ?". Perhaps that had something to do with the point. Sir Frank Colyer had recently shown her, in the museum of the Royal College of Surgeons, the skull of a child whose occlusion showed the typical signs of thumb-sucking, and the condyles of the mandible were definitely bent, to compensate, so Sir Frank Colyer thought, for the pressure from the habit.

If the skeletal pattern was genetically determined, that did not necessarily mean that it was unalterable except by surgical interference, as Mr. Ballard had said. Professor Harris, in his book " Bone Growth in Health and Disease," showed the lines of arrested growth in the long bones corresponding to illnesses at various ages, and those illnesses obviously altered the genetically determined pattern. What reason was there to believe that other factors, such as function and pressure, might not also cause alterations ?

Moreover, it was known that the vertical overbite varied at different periods in the normal development of the deciduous dentition. Surely interference at certain stages during that development might prevent normal vertical growth, and that might be quite independent of any alteration in incisor inclination.

She thought that a great deal more proof was necessary before Mr. Ballard's theory should be used as a basis for treatment or—even more important—as a basis for teaching.

Mr. J. H. Hovell agreed with Mr. Ballard that the form of bones was genetically determined and said he thought it should be borne in mind that it was the form and not the size which was genetically determined. The size could be altered by environment and by disease. An alteration in the size was accompanied not by an alteration in the form but by a general diminution in size and, in the case of the skull, by a diminution in all the facial bones, both of the maxilla and of the mandible. No increase in the genetically predetermined normal size could be obtained by any means whatsoever. The normal size was that which the bones would reach if given optimum conditions.

Nothing that orthodontics could do would increase the normal size or alter the shape of the bones.

Mr. H. Chapman said that he had been looking forward to Mr. Ballard's paper for a long time, but he found it very difficult to follow in its entirety and he thought it needed careful study when it was available in print.

From his own clinical experience he could not help thinking that the position of the mandible in relation to the maxilla could be changed without very much difficulty. He thought that in children of about two years of age he had changed the mandible from a prenormal position to a normal position by the use of a head and chin cap, but apparently Mr. Ballard thought that would be impossible. The relations of the teeth had certainly changed, and, so far as he knew, the pressure had been only on the chin, to make it go backwards, except in one case, in which a bite plate had been used to open the bite, and he did not think that in that case there had been any stress to help the upper incisors to go back. In another case, which he had seen only three times, in addition to the head and chin cap an inclined plate had been used, which also opened the bite.

With regard to the use of intermaxillary traction, in one case in which Mr. Ballard had definitely shown a change in the relation of the molars, the molar change in the upper appeared to be rather greater than that in the lower. If one was using intermaxillary traction to bring the lower forward or the upper back, one was dealing with a relatively loose mandible which could come forward quite readily. The force was equal to bring the mandible forward and to bring the maxilla back. It seemed to him that there must be considerably more force necessary to drive all the upper teeth back through the bone than was required to bring the mandible bodily forward with the teeth. He believed that as a rule, in treating such cases, he brought the mandible forward with the teeth as one component. If the teeth were moving backwards, the idea of anchorage must be different from what he imagined it to be, because surely the upper teeth offered much more resistance to movement distally than the others. Of course, tilting back of the upper teeth occurred, but at the same time the jaws were moving forward as well, and he thought the President had shown in his Address at the last meeting how easy it was for the mandible to grow forward, perhaps on account of the portion of actively growing bone from the condyle towards the mandible. He would have thought that the intermaxillary traction acting on that might affect the teeth quite readily. Therefore, whilst he agreed that it was not possible to increase the size of the bone at all, it seemed to him that it was possible to change its form in some manner whereby the occlusal change took place.

He did not want to throw doubt on Mr. Ballard's work, because he was unable to appreciate it sufficiently at the moment and required to study it further.

An interesting paper had recently appeared in the American Journal of Orthodontics, describing a case in which all the upper teeth were being pushed back by means of a bow clip and a head and chin cap, so that there was no traction on the lower at all. In that paper there was no mention of extractions, so he wondered what was happening at the back, because the teeth that had been pushed back must go somewhere.

He wished to thank Mr. Ballard for his paper, which he looked forward to studying when it was published.

Mr. J. Sherwood, referring to the action of the skull cap, asked what happened when it was worn. Did the form of the bones change or was the action of the muscles altered ?

Mr. R. B. D. Stocker said it seemed to him that in the discussion about the genetic pattern and the skeletal form the speakers had used those expressions in different senses. Personally he thought that the genetic pattern must be the innate genetic pattern, which *ipso facto* must be unchangeable, whereas the skeletal form was the product of the genetic pattern and the environment. He would suggest that the genetic pattern set some limits of size and form for the development of the

skeleton, and the environment determined where within those limits the final form should fall.

With regard to the difference between American and English people in this connection, he wondered whether it might be due partly to the fact that in America fewer deciduous teeth were extracted.

Mr. C. L. Endicott said he would like to congratulate Mr. Ballard on his paper, into which he had obviously put a tremendous amount of hard work and thought and which was both controversial and interesting. It was a paper on which there could be a very long discussion without much being finally decided. There were a few practical points in the paper with which he did not agree.

One of these points was the taking out of second molars in preference to premolars, in cases in which extraction had to be carried out. That meant in effect sacrificing two units from each section of the jaw rather than one unit, as when a premolar was extracted. Also, in many cases, especially if the patients were very young, the removal of the premolar relieved the crowding in that part of the arch which was most in need of relief, and it facilitated, he thought, the final correction of the case. There were definitely cases, however, especially where large third molars were developing, in which it was obviously preferable to take out second molar and not premolars.

He believed Mr. Ballard had stated that when two upper premolars were extracted the result was often a very deep overbite. He would be interested to hear what Mr. Rix had to say on that point. because at the last demonstration meeting Mr. Rix had shown a series of hospital cases in which two upper premolars had been extracted and had demonstrated that an improvement in the incisor overbite had followed in every case. From what he himself could recall of the clinical cases on that particular point, that seemed to him to be the general tendency.

Another practical point raised by Mr. Ballard was in regard to the treatment of Class II, Div. 1, cases with intermaxillary traction. Mr. Ballard had emphasised that the lower teeth were either moved or tipped forward. Personally if he was using traction on a case he took great care to prevent, if he possibly could, lower teeth coming forward through the cancellous bony channel, because in the end, although the incisors might be tipped up into alignment and a quite good alignment produced, very often the incisors were tipped too far forward and the permanency of the result was most difficult to secure. It was very discouraging to see the incisors buckle up and imbricate.

Dr. Tweed frequently referred to "forward translation," and personally he thought that it was forward translation, where the amount of bony tissue was not commensurate with the amount of tooth tissue, with which orthodontists were coping in many of their cases. He was interested in the origin of the term "forward translation," because he knew that for many years Dr. Grieve of Toronto had been endeavouring to convince Dr. Tweed and others of the necessity of extracting teeth in some orthodontic cases, and time after time Dr. Grieve had been shouted down at meetings of the American Society of Orthodontists for advocating extractions in certain circumstances, the view being taken that extractions were never indicated in any case. Incidentally, he might say that he thought some orthodontists were inclined to extract teeth in many cases in which they need not and should not be extracted. When one saw adults who had had extractions done when they were children, it was often plain that the extractions should not have been done. He happened to know that Dr. Grieve had been influenced in his decision regarding the need for extractions by Dr. Sim Wallace. In an article written by Dr. Sim Wallace many years ago, the term "forward translation" was used, and, although the term appeared frequently in American orthodontic literature, he thought it had really originated with Dr. Sim Wallace.

With regard to the change which might take place in the cases in question, he had been amazed by the rapidity of the change which took place in some Class II cases when the Norwegian splint was used.

At the Eastman Dental Clinic there had been several cases in which the use of the Norwegian splint had produced not only a very rapid but a very considerable change of some sort. He had seen Class II, Div. 2, cases in which, when the upper incisors or an obstruction of any nature in the upper arch was removed, the lower arch rapidly came forward into its normal relationship with the upper arch, even without intermaxillary traction or any other encouragement. A change of some sort must take place there. He thought that Mr. Thompson had explained it as logically as anyone in his article on the free-way space.

He wished to thank Mr. Ballard very much for his valuable paper.

Mr. N. J. Ainsworth asked Mr. Ballard how he determined what was the true apical base relationship.

Miss K. C. Smyth said that she would like to thank Mr. Ballard for a singularly keen and single-minded piece of research work.

The work done by Professor Rushton and Mr. Wilson Charles had left no doubt in her mind that there was a possibility of change in the region of the neck of the condyle. The case which Professor Rushton had shown of the extreme lengthening of the condyle must surely prove that it was susceptible to change, and she thought that, in the case of a young child, if the lower incisors were brought in front of the upper incisors and one was able to true them it must make a difference to the condyle and glenoid fossa relationship. If the abnormal incisor relationship was left uncorrected the condyle and the glenoid fossa must surely develop in an abnormal way, whereas if it was corrected they would be free to develop in a normal relationship. She therefore felt that early orthodontic treatment must make a difference in the glenoid fossa and condyle relationship.

She would like to know whether Mr. Ballard could produce profile photographs, as comparable as possible, to show the change or absence of change in the relation between the upper and lower apical base from the clinical point of view, from the point of view of observing the actual changes in the profile, or did he think that such photographs should be produced ? She thought that some orthodontists believed, from photographs taken before and after treatment, that there had actually been a change of facial appearance observable to the expert and to the layman, and she would like to know whether Mr. Ballard had checked up on that point by ordinary facial photography.

Mr. C. F. Ballard, in replying to the discussion, said that in his paper he had obviously said too much and too little.

He did not think that he could answer Professor Rushton without assessing all the evidence and producing another paper. He had read all the literature that he could obtain on the relationship of the mandible to the maxilla, and the general conclusions were that the skeletal pattern could not be changed. One could get a general arrest of the skeletal pattern, but that did not change the skeletal pattern. The skeletal pattern was the same but a little smaller ; it would not reach its optimum development. Dr. Brodie and others in America had assessed by radiograph the results of their orthodontic treatment and had come to the conclusion that the orthodontic changes were entirely the result of dento-alveolar changes and not changes of skeletal pattern. He had tried to demonstrate that from the analysis of cases that he had shown. If one took a typical Class II, Div. 1, case in that analysis, his assessment of apical base relationship meant that to produce a perfectly normal occlusion it was not necessary to alter the skeletal pattern at all ; it could be done by a change of the axial inclination of the teeth alone. If one started with an abnormal axial inclination of the teeth and then changed the skeletal pattern, one would put the teeth into an abnormal incisor relationship. That was what he had tried to show. If one altered the skeletal pattern in the 25 cases in question in the analysis of cases that he had shown, one would not produce a normal incisor relationship ; consequently the normal incisor relationship must be produced by a change of axial inclination.

In reply to Mr. Ainsworth, his assessment of apical base relationship was on

the axial inclination of the lower incisors. In the 135 cases shown in the analysis, there were eight cases in which it had been assessed clinically that the lower incisors were so retroclinated and the upper incisors so proclinated that it would never be possible to establish normal axial inclination of the teeth. If the lower incisors had been tilted forward until they were at right angles to the mandibular plane and the upper incisors had been tilted back until they were at their correct angle to the Frankfort plane, the result would have been a Class III occlusion.

He did not put this forward as proved. He hoped, as he had said at the end of his paper, that it would be possible to assess the results by lateral radiographs, and he believed that, when it was possible to do that, it would be found that it was not necessary to alter the skeletal pattern to produce normal occlusion, in the majority of cases.

He had quoted Dr. Brodie, Dr. Brash, Mr. Thompson and others, and there were many other people who did not agree that skeletal pattern could be changed except by gross pathology or gross trauma. He had had many instances of a child with a skeletal Class II being so conscious of her inferior retrusion that she had held the mandible forward for many years to correct her profile abnormality, and yet there had not been a change of skeletal pattern. One could still get one's little finger behind the condyle and she could still get her mandible back. Surely, if it was possible to change the skeletal pattern by environmental factors, that holding forward of the mandible for five or six years would have produced a change.

With regard to the variation of overbite in children, there were two factors to be considered. One was that when teeth were erupting one could not use the short overlap as an assessment of overbite, because only part of the tooth was through the gum. Secondly, Dr. Brodie had shown that the axial inclination of the incisors changed ; he had shown that the deciduous incisors started by being rather retroclinated to the mandibular plane and slowly uprighted themselves, producing an overbite.

With regard to the question of photographic proof of the change, he thought that in fact photographic proof was useless, because normal occlusion had been produced by changing the axial inclination of the teeth. The bringing forward of the lower incisors and the taking back of the upper incisors and the upper lip produced a startling change in profile, which would be quite deceptive if one attempted to assess the apical base relationship on photographs. He thought it had to be done with accurate lateral radiographs.

As to the removal of teeth, to which Mr. Endicott had referred, that was a very big question. If one had to move tooth substance and if the axial inclination of the maxillary segments was correct and one could definitely assess a forward tilting of all the teeth in the maxillary buccal segment, then he would prefer to move the segments, because he did not like the breaking of the contact points. If the contact points were broken by the removal of teeth, they were always liable to remain open, with the possibility of caries resulting. In some cases the upper 6 tilted back, and it was not possible to get the buccal segment back without first correcting the tilt of the upper 6.

Mr. Endicott had also referred to Mr. Rix's demonstration of the deep overbite. He had mentioned in his paper that the overbite of the skeletal Class III was very variable ; it varied from a very deep overbite to an edge to edge bite. Speaking frankly, he did not quite understand that variation and he thought that it needed investigation and explanation. In the case of a skeletal Class III, with crowding in all four buccal segments, experience at the Royal Dental Hospital had shown that the four first premolars could be removed without any risk of the collapse of the lower arch and without any risk, therefore, of increasing overbite. It seemed that in the skeletal Class III the retroclination of the lower incisors would not increase if the lower 4's were removed. If one removed the lower 4's and tilted back the canines, and the canines stayed where they were put, the lower incisors did not increase their retroclination to fill up the space. He thought that Mr. Rix's cases which

showed an increase of the overbite were of the skeletal Class III type. Dr. Brodie had shown a forward tilt of the lower incisors slightly increasing the overbite, and he thought that was probably what had happened in Mr. Rix's cases.

He was quite willing to agree with Mr. Endicott that the Norwegian appliance would produce exactly the same change as intermaxillary traction, and he believed that as a means of producing the change it would be a very useful appliance, some very startling and rapid changes had been produced with it at the Royal Dental Hospital, but it had not been used in a sufficient number of cases there for him to put forward a definite opinion about it.

He would not attempt to produce any evidence for his theory, which was based on clinical observation only, but when accurate lateral radiographs could be produced he thought it would be shown that it was not necessary to change skeletal pattern in the majority of cases.

On the motion of the President, a vote of thanks was accorded to Mr. Breakspear and Mr. Ballard, and the meeting then terminated.

* * * * *

OBSERVATIONS ON A VISIT TO THE UNITED STATES OF AMERICA

By K. E. PRINGLE, L.D.S.

LAST AUTUMN I had a very interesting trip to the United States of America. This was sponsored by Guy's Hospital Dental School. I tried therefore to look at things I saw from the point of view of my school. At the same time, as I held the office of Honorary Secretary to this Society, I was received partly in that capacity. I should add though that my new found friends received me not only officially but simply as a man and treated me in such a handsome and generous way that I feel very much in their debt.

For some two years before my visit I had been having correspondence with Dr. J. A. Salzmann, whose encyclopædic book *Principles of Orthodontics* has been so much read here. It was largely to him that I turned for personal introductions and I am very much indebted to him. Right from the beginning he gave me the freedom to visit him at his office or at Mount Sinai Hospital, where he recently started an orthodontic clinic. Finally as Director of the North Eastern Society of Orthodontists he together with Dr. Eby arranged for me as your Honorary Secretary to be entertained as the guest of that Society at their very interesting two day meeting at the Waldorf Astoria in New York last November.

I was very happy on that occasion to meet many of the well known orthodontists headed by Dr. Mershon whom I had already met in Philadelphia. Present also on that day were our three corresponding members Drs. Sillman, Gosman and Goldstein. All sent good wishes. I was grateful when the President Dr. Ross of Philadelphia called on me. The morning had been devoted to an evaluation of the many valuable contributions to different fields of knowledge of the late Dr. Milo Hellman.

I tried therefore to express shortly the regard with which Hellman's work was held in England. I also delivered the message of goodwill with which I had been entrusted by last year's President Mr. Robert Cutler.

I shall give you my impressions of this visit under three headings.

1. Orthodontic Research.
2. Orthodontic Teaching.
3. Orthodontic Treatment.

Orthodontic Research

I went rather in this frame of mind: here at Guy's we have a very large amount of material for orthodontic treatment and clinical teaching. Why is it that when it comes to research or even writing a scientific paper we have so much difficulty in bringing our material together? What can we learn from others? Do not misunderstand me. I think we have at least done our bit over the last twenty years but it hasn't been at all easy.

Preparation of Clinical Models

The method in general use is to cast the teeth and alveolar portions in stone and to use plaster bases made with model formers of rubber, plastic or metal. I like the plastic ones best but they are somewhat easily broken and I think for a large institution rubber ones are probably better.

In many cases these model formers are used only to give approximate shape and the next stage is made with a very large carborundum wheel running on a lathe. The model is rapidly trimmed on the face of the stone.

There are several makes, the more expensive ones being sometimes covered with white plastic material; the less expensive ones with metal.

In some cases there are two wheels, one coarse and one fine on either side of the lathe.

My enquiries elicited that the following points are desirable :—

1. The stone covered in except for a small area on the face against which the model can be trimmed.

2. A horizontal platform below this space on which the model can be placed. This platform should have a small vertical lip on the left hand side.

3. An adequate supply of running water entering at the top.

4. A really good large rubber tube for draining water and powdered plaster. At Columbia they have an ingenious device consisting of a wedge of wood which gives correct angulation between the base line and the sides of the models. Others use clear plastic protractors and simply mark a line to trim to. Fine sandpaper can be used for finishing and a soap solution for final polish. The soap solution can be of Castile soap.

The use of the gnathostat with models oriented to the Frankfort plane is not common, but it is used by Dr. Salzmann in his office, by the postgraduate students at Columbia University and by others. I have always wondered while admiring those of my friends on both sides of the Atlantic who go through this procedure whether its use for general purposes is really a necessity.

A few models constructed for teaching purposes seem to me enough to show that the occlusal plane, which is generally used is very inaccurate but I wonder whether the Frankfort plane itself is not rather a deceptive guide.

In one of his lectures to post-graduate students at Columbia to which I was invited Dr. M. Diamond showed slides of three different skulls all showing normal occlusion but with completely different relations between the Frankfort plane and the line of occlusion. One had a wide angle, another a less wide. In the third the lines were nearly parallel.

Storage of Models

Gnathostatic models being large present something of a storage problem. Salzmann and others use a cabinet with shallow drawers deep enough to take models lying on their backs. Each drawer has several raised fillets of metal or wood so that the models can be placed in rows.

Profile Radiographs

Of the cephalometers that I saw (I didn't see every one) that of Dr. B. H. Broadbent was far and away the best. We have used his diagram at Guy's for some years for teaching purposes. I was very impressed with his work at Western Reserve University in Cleveland, Ohio. He has everything very nicely arranged so that a visitor can look at lighted wall cabinets with series of X-rays showing development, normal, abnormal and so on.

He has also some beautiful stereoscopic X-rays. I fancy that Dr. Broadbent has a great many visitors, so I was very grateful for the way in which he received me and answered my many questions. He has a happy way of answering any question you put quite straightforwardly and then producing a series of slides to prove his point.

His method of storing slides is excellent. In a metal cabinet he has vertical frames which move forward on runners. Across these frames are arranged horizontal metal holders along each of which a number of slides can be placed. In this way a very large number of slides can be kept. They are easily accessible and easily examined without removal from the frame. If necessary of course they can be taken out.

Incidentally, once you leave the factory area, Cleveland is a very pleasant place. There is a most attractive drive by the side of Lake Erie and the countryside is charming.

Clinical History Taking

I took pains to collect ideas on history-taking without, I am afraid, finding exactly what I wanted. We were not very satisfied with the dental letters in use in the Children's Department at Guy's. They consist of a front page on which the history is supposed to be filled in, a second page with a space for an outline of the treatment advised by the surgeon and the remaining sheets for description of the treatment with space for signature by

members of the staff. When additional sheets are required these are stapled inside the original sheet.

This is not too bad from the point of view of treatment, but it does not keep material together, which is very important for research and teaching purposes. To keep models in one place, history and treatment chart in another, photographs in another and X-rays in yet another is very wasteful of time and effort and often results in the loss of one or another of the necessary items. Somehow I feel that all these items have to be kept together and in the same room.

Models of course have to be separate. After examination of a large number of history charts, some very simple, some very elaborate, Mr. Rix and I have designed a new history chart for use at Guy's which we hope will in time prove of value to us in our investigations.

I think for a small concern with no great numbers of men participating an envelope form such as is used by Dr. Salzmann at Mount Sinai Hospital would be best but in a very large institution such as ours I would be afraid that many of the data items would not be replaced and would therefore be lost, if the patient had the handling of it as at present.

We are hoping to compromise by giving the patient the sheet with written history with day to day record of treatment and appointments and to keep a separate folder with X-ray photographs and the typed history ourselves in the Children's Department.

So I make these suggestions :—

1. That all relevant data should be kept together in one folder.

2. That all folders should be kept in the charge of the department concerned and should not be handled by the patient.

3. That case history taking should not be too elaborate, as experience shows that people simply will not fill in elaborate sheets. On the other hand a case history left entirely to each individual will not produce anything for comparison.

Orthodontic research does need a certain amount of self discipline to keep material together but I think without being too elaborate in our organisation we could help ourselves considerably.

The Maxillator

Salzmann has designed a most ingenious piece of apparatus, which he calls the Maxillator which is capable of measuring as far as I could see any line of angle of the head or the teeth. I hope one day he will give us the data which he is collecting by the use of this instrument.

Photography

One method of obtaining clinical photographs is to use a small *Agfa* camera. By the sides of this are two 500 watt bulbs and two handles. Focus is obtained by means of four rods which project in front of the apparatus. The apparatus is held so that the rods are just short of the patient's face.

Orthodontic Teaching

Undergraduate Teaching.

As a general rule the undergraduate student attends a pretty full course of lectures and has to do a course in technique but nowhere did I find undergraduates being given responsibility for treatment in the way we have at Guy's and perhaps more important, nowhere was there the system of clinical teaching to a group of students by the senior staff on each case such as operates at Guy's.

There each case is considered with available data, history, models, X-rays and sometimes photographs by the dental surgeon with his group of students. Diagnosis, plan of treatment and prognosis are discussed.

There are definite advantages in this system, which gives to the student the opportunity of receiving clinical teaching from senior members of the staff on a large number of cases and I remain firmly convinced that our system of undergraduate training with its many faults does give to the student a very fair grounding in the subject and a pretty balanced viewpoint.

Postgraduate Teaching

Columbia University of Oral and Dental Surgery gives a full time 12-15 months postgraduate course in orthodontics under the Professor of Orthodontics Dr. A. F. Totten. It is a good course. The graduate

receives a very full course of lectures on theory and practice and carries out treatment for cases attending there. The various aids to diagnosis such as profile X-rays and the use of the gnathostat are used.

No one technique is taught exclusively but they have there as one of their instructors one of the best known exponents of the Johnson Twin Arch, Dr. Madden. Remembering that I was looking for the things that might be useful at home I took some trouble to see this appliance at work in various hands and attended several papers devoted to its use.

Certainly it works very well particularly in experienced hands and I am very grateful to Dr. Madden for the trouble which he took on my behalf.

The Department of Orthodontics forms with the Department of Pedodontics under Prof. MacBeath, who, incidentally, also arranges an excellent Postgraduate Course, one section of the Dental School.

The Dental School occupies two floors high up, in the Medical Center. The Dean, Dr. Bion R. East most kindly made me a Visiting Scholar and gave me full facilities. He is at present trying out a very promising form of cubicle the sides of which are formed by cabinets containing everything a man could wish but quite simply arranged. I think this may well come to be imitated by other new schools as they come to be built.

I had some very interesting talks with postgraduate students about to complete their course. Dr. Granerus of Sweden, one of our corresponding members was there.

He told me that he was writing his thesis on the principles of the Norwegian System. I found the most profound ignorance on this subject everywhere I went. John de Villiers of South Africa who graduated at Guy's and Dr. Tessier of Albany, New York who were both recently elected as corresponding members were also there.

De Villiers very kindly gave me his demonstration model showing the Johnson Appliance and I can remember a very interesting and long talk with these two men in the very small bedroom in my hotel. They have magnificent facilities at the Medical Center. The student's hostel is very nice and the students lunch room has a delightful view of Washington Bridge and the Hudson River.

At New York University Dental School at which a lot of reconstruction was going on I had the feeling of being at home.

The buildings right in the middle of New York are not as new as those of some schools but there is tremendous activity there. You get the impression that the Staff and the students, undergraduates and postgraduate are all hard at work on the many patients.

Dr. Samuel Hemley took me along to one of his lectures. The subject was the history of the bite plane and the inclined plane from Kingsley onwards. He lectures very well. I was glad to find as he went on that his experience had been very similar to our own and that the inclined plane as a way of altering arch relationship by change at the temporomandibular joint was in his experience only very rarely successful and then only when the mandible so to say wished to come forward. He made the suggestion that changes of the mandibular joint are uncommon because of the cartilage which unlike bone is strongly resistant to pressure.

Lectures that I heard were much more easy to follow than papers given at scientific meetings as over there they find it necessary when reading a paper to quote verbatim from many other writers.

So you find with scientific papers that it is often difficult to tell what it is that a man really wishes to say on his own account. A lecturer on the other hand is much more free and can develop his arguments as he wishes. I asked Dr. Edward Appleton, Dean of the Thomas W. Evans Museum and Dental Institute School of Dentistry at Philadelphia, commonly known as Penn, whether I might attend one of his lectures.

I had already heard a good deal about Dr. Appleton from men who remembered gratefully how he had vetted their scientific papers, had practically rewritten them and then had encouraged them to think that the final product was their own. Dr. Appleton is a bacteriologist by profession

but his interests are wide and you find him in New York listening to two days papers on orthodontics. His school is charming and has the traditional university atmosphere.

The orthodontic department is at present being reorganised by Dr. Ross with the help of Dr. Marcus.

Dr. Krogman has recently been appointed Professor of Physical Anthropology. He has his own department but it will be very interesting to see what comes of the close operation of these two departments. They have a very nice little set up here in their excellent library. Screened off in one corner you find a small lantern and screen which can be used by the student.

Boxes of numbered Kodachrome slides of clinical conditions are used. For each slide there is a typed history. After the history there is a discussion of the lines of treatment and finally a list of references. I think we must copy this for orthodontic education.

The other school in Philadelphia is Temple. The Dean, Dr. Timmans invited Dr. A. F. Jackson, who I am happy to say has been appointed Professor of Orthodontics in this school, and myself to inspect the new building, which was rapidly being prepared for the school. This surely will be the largest and probably best equipped Dental School in the world.

The Department of Orthodontics adjoins the Department of Pedodontics, a movable screen being contained in the party wall so that if necessary more chairs can be temporarily allotted to one subject or the other.

I shall be very interested to see what Dr. Jackson makes of this department. I have met and watched a number of young orthodontists, whom he has trained in his office and I must say that their work is very impressive. Now Dr. Jackson has the opportunity to enlarge his teaching sphere and I for one would be most happy to be postgraduate student at Temple.

My impression is that the best practical orthodontic training a man can have is to work in the office of an experienced man like Dr. Jackson or Dr. Lowrie Porter. These men are not one-appliance men and having several surgeries in their offices they can share the cases with their juniors allowing them to come to more difficult techniques gradually. In some cases all can work together making complete upper and lower fixed appliances. I saw this done in Dr. Jackson's office so that in $1\frac{1}{2}$ hours molar bands and canine bands and upper and lower bows with the necessary springs were not only constructed at the chairside but cemented in position. The child incidentally was less perturbed than if one operator had tried to do half the work.

Several other children were seen for adjustments during the same period. The three operators seemed to think nothing of it.

Another method of training of which I heard but did not see, is that of Dr. Johnson, who teaches the use of his own twin wire appliance. Dr. Johnson with two other men Dr. Crozat and Dr. Madden holds an intensive fortnights' course limited to orthodontists. There was to be one of these shortly after I left at Columbia. Many men testified to the value they had obtained from such a course.

Orthodontic Treatment

I had often wondered what technique was used for making bands in the States. To my surprise I found that there were many techniques some of which I had myself tried and found very cumbersome. Porter's method of using a Johnson loop band is a very practical and accurate one and I think that for incisors ring bands with buccal flanges attached which are pinched and soldered on the palatal side are probably as good as any.

Welding and Soldering

I have for a long time felt that a welded joint was really only the best joint for stainless steel in one particular place. It is very good for making the ring to construct a moler band, i.e., to join two pieces of band material together. For all other joints it is my belief that, if a suitable flux and solder could be found soldering would be preferable, except of course for the addition of auxillary springs where

winding is usually the best method as it gives no loss of temper.

Not wishing greatly to add to expense, particularly for hospital practice I have been on the look out for several things.

1. A more pliable band material in stainless steel or chrome alloy.
2. A better flux than has up to now been available in England.
3. A better solder or simply a lower fusing silver solder.
4. A finer bunsen burner than is usually found in England.

I have hopes that these will soon be found. In fact some of them have been found, the compressed air bunsen burner having been used for many years in this country but rather forgotten with the advent of welding. Time will show but I am very grateful to Mr. Reubens of Beta Orthodontic Supplies for the trouble he took with my problems. At the meeting of the North Eastern Society this firm showed a chrome alloy, which I am shortly hoping to try here.

They also showed an ingenious device for demonstrating approximately what would be the result for different lines of treatment in a particular case, say a Class II, Div. 1 case.

Original models are made and several duplicate models constructed. Then the teeth of each duplicate in turn are removed and reset with wax in the approximate positions they would occupy after each line of treatment. Thus if the treatment was to consist of expanding upper and lower arches the teeth would be reset thus. Needless to say having seen the new positions nobody would start treating his case along these lines, and so on. It does give some idea of how ludicruous are some of our conceptions of what is possible.

Devices for ascertaining what forces you are using are on sale in the U.S.A. One looks rather like an automatic gold plugger with a hook at one end and a flat piece at the other so that traction and pressure forces can be recorded. I have seen ingenious hand made gadgets, which are in use in this country but I hope we shall soon have an accurate device of this kind readily available.

Appliances

Johnson's twin arch used in its right place, Jackson's labial appliances with their excellent anchorage used as he uses them in their right place and Porter's device for distal movement of upper first molars or the upper buccal segment and other appliances are well worth study here. The mention of Dr. Lowrie Porter reminds me of excellent advice that he gave me. He told me that if you are considering removal of upper third molars and distal movement of the upper dental arch it is always well to X-ray for the inclination of the upper second molars. If these are inclined distally the appliances will increase this so that it is sometimes preferable to remove the upper second molars rather than the third molars.

One observation I made was that most of the cases under treatment were substantially older than ours. I fancy that if you are using fixed appliance techniques this is quite an advantage when it comes to banding the teeth.

A paper given to the North Eastern Society of Orthodontics by Dr. Bercu Fischer interested me very much. He divided cases which might be described as Class II, Div. 1, from the models and convincingly showed that Class II, Div. 1 was not a condition which had to be thought as having one line of treatment applicable to it. I do not think anybody believes that it is but it has sometimes sounded like it.

It may well be that the last word on Angle's Class II, Div. 1 has not yet been spoken but from my point of view it is good that there should be full recognition that it does not represent just one condition with just one possible line of treatment.

At the conclusion of his paper I presented Dr. J. A. Sillman's film "Serial Study of Occlusion from Birth to Ten Years of Age." This film by means of serial models of five cases, shows the development of occlusion, normal and abnormal. It also shows many of the effects of early loss of temporary teeth and shows the possibilities of treatment of some minor forms of malocclusion by means of spot grinding of the deciduous dentition.

The President, in expressing his appreciation of Mr. Pringle's paper, said he was very pleased to hear of the extremely friendly way in which Mr. Pringle had been received in the United States. While that had no doubt been due in large measure to Mr. Pringle's own personality, he thought that it also reflected friendly feelings in America towards the Society and its members.

It was evident that Mr. Pringle had travelled about America with an extremely practical and even acquisitive eye, and not the least interesting of the things which he had shown that evening were the equipment and the notes on technical methods, which the members would no doubt wish to study and perhaps adapt to their own use.

It had been a great privilege to see Dr. Sillman's film, which must be the fruit of ten or fifteen years' work. The film was an excellent method of presentation, as it enabled one to see one's cases from the beginning to well on in life and to look at any point again when one wished to do so.

He had been fascinated by the way in which the lower jaw seemed to shoot forward in the first months of life. He did not quite understand how Dr. Sillman recorded the interval between the baby's jaws. Did he just put something soft in between and ram them together ? Was the interval that he showed and measured one that definitely existed in the child, or did it merely indicate how hard Dr. Sillman pushed ?

Miss L. M. Clinch said there were many questions that she would like to ask Mr. Pringle about all that he had seen in America, but she proposed to concentrate on Dr. Sillman's work and the film that Mr. Pringle had shown, except for saying that if Dr. Broadbent was coming to England this year she thought the Society should try to persuade him to read a paper at one of its meetings, as she considered that the work which Dr. Broadbent had been doing was much the most important, from the orthodontic point of view, that had been done for many years.

She had been greatly interested in Dr. Sillman's work for a considerable time. His serial models of young children could teach orthodontists a great deal. In the American Journal of Orthodontics (*September*, 1947) Dr. Sillman described 24 cases which had been followed from birth to 7 years of age and 24 cases which had been followed from birth to 10 years of age. Those cases and the pictures that Mr. Pringle had shown that evening showed that there was no doubt of the varying degrees of posterior positioning of the mandible in the infant, and it appeared that as development progressed the mandible came forward into a normal relationship with the maxilla, however posterior its original position had been.

In all the cases shown by Dr. Sillman there had been no gross maldevelopment, most of the malocclusions that had occurred having been due to local causes, such as early loss of deciduous teeth. That might seem strange if it was not remembered that the general opinion was that gross maldevelopments occurred in only about 3 per cent. of the school population, whereas abnormal occlusion was much more common. In examining 62 children between 3 and 5 years of age last year, she had found that 60 per cent. had normal occlusion. She attributed that to two causes : (1) a temporary disproportion in forward movement due perhaps to subnormal health, and (2) a habit the ill effects of which, when the habit stopped, would be overcome by normal growth.

Dr. Sillman showed graphs of the pattern of change in size of the arches, and it was interesting to note that in the normal occlusion cases the periods of increase corresponded almost exactly with Professor Harris's " springing up " periods in the skeleton as a whole. One of those periods was early in the first year, when all the forward movement took place in the mandible, and another from 5 to 7 years of age, during which she thought that the early temporary disproportions were overcome. She would like to know, however, whether ill health at a critical period of development might not permanently prevent the forward movement of the mandible, particularly in the cases shown where its position at birth had been so very posterior, and whether that, combined probably with hereditary influences,

could not produce the typical gross post-normal mandibular occlusion. It would be a great advantage if orthodontists could follow some of their cases backwards !

There were two points about which she would like to talk to Dr. Sillman, and perhaps Mr. Pringle could enlighten her on them. The President had already mentioned one of them, namely, Dr. Sillman's method of taking a wax bite to establish the relationship of the jaws at birth. In his last paper Dr. Sillman pointed out that the taking of a bite at birth could not be compared with the taking of a bite in an edentulous adult, and she herself had pointed that out many years ago. There was a definite antero-posterior bite of the gum pads, and that was obtained repeatedly, but how did Dr. Sillman know the vertical resting position of the mandible so that he could show his models with the molar gum pads at varying distances apart ? That they were apart at rest was known from radiographs, but to judge the degree on a wax bite must be extremely difficult, in view of the fact that the temporo-mandibular joint of the new-born child had no articular eminence and the glenoid fossa was practically flat, and the whole articulation depended for its stability on the ligaments surrounding the joint. If any force was used the condyle would be withdrawn from the shallow glenoid fossa.

Secondly, if, as Dr. Sillman said, he could repeatedly get the same antero-posterior relationship when taking the bite why did he say that there was no occlusion ? To support that, he showed cross-sectional casts of the same child from birth to 3 years of age made posterior to the canines and noted the flattening of the gum pads in the later cases, due, he said, to occlusion. The erupting teeth, however, would cause this widening or flattening. Also, if Dr. Sillman was going to show serial models should not he show the resting position of the mandible all through the series, i.e., show the molars apart as well as the gum pads ? Personally she thought there was a definite occlusion of the gum pads, just as there was of the teeth, and that it was inconsistent to show the so-called " freeway space " in the early models and not in the later ones, although she thought the space before the teeth erupted was greater than it was later.

She was glad that Dr. Sillman now recognised the space in the incisor region between the gum pads, as distinct from the " freeway space," and she was even more gratified that he considered that a relationship existed between the form of the space at birth and the subsequent dentition, although not perhaps the relationship to close bite that she hoped, though he did show one case with a very large space which subsequently developed an open bite.

She had always taken a great interest in Dr. Sillman's work and had corresponded with him, but she felt that one conversation with him would clear up most of her queries. She could say from experience that one got the " feel " of an infant's head and jaws, and, although methods of bite taking and bite fixing might not seem to follow very hard and fast rules, with experience one got the same result time and time again.

She had enjoyed Mr. Pringle's paper immensely, and if he could clear up any of the points that she had raised she would be very grateful to him.

Mr. R. E. Rix, referring to the question of the amount of pressure that had to be applied to bring the gum pads together in the case of a child that normally did not keep them together, said that a considerable amount of force was required. The gum pads could be forced together, but they parted again with a spring.

Mr. H. G. Watkin, having thanked Mr. Pringle for his paper, which he had very much enjoyed, said he would like to know whether Mr. Pringle had seen in America the milling wheel which was used for the preparation of models. He himself possessed one and found it very efficient. No water was required, the wheel cutting the model very easily and quickly in the dry state.

With regard to the question of keeping radiographs in one place and the models in another, he himself always kept them in the same box.

Mr. N. Gray said he would like to thank Mr. Pringle for a very interesting evening.

He had been struck by the fact that orthodontic knowledge seemed to be more general nowadays. There did not appear to be such a sharp contrast as formerly between England and America in that respect. He thought that orthodontists in this country had gained a good deal of knowledge in recent years and were now able to talk to American orthodontists on equal terms. It appeared that Mr. Pringle had had a good deal to contribute from Guy's Hospital in London to the Columbia University in America.

He would like to ask Mr. Pringle whether he had noticed in America any systematic method of picking out certain types of cases in indexing, so that one could refer easily to special cases, such as types of Class II, types of supernumerary teeth, and so on. He had found it difficult to systemise the work that he was doing. There were so many cases and they got lost in the general rush and bustle of life. He would like to know of some method of picking out types of cases.

He thought is must be difficult to take models from very young babies, although in the film it appeared to be easy. He had tried to take a model from one of his own children and it had very much upset the child's mother.

Mr. R. B. D. Stocker asked Mr. Pringle whether he thought that deciduous teeth were lost more often or less often in the United States than they were in this country.

Mr. G. E. M. Hallett, after thanking Mr. Pringle for his very interesting paper, referred to the Salzmann Maxillator which was mentioned in the paper and said he did not know whether any of the members had tried to construct one from the diagrams which Dr. Salzmann published in the American Journal of Orthodontics some time ago. He himself had done so, and he had found that, although it would take certain angles, it seemed to be modelled on rather heroic proportions, and he felt that for English material the measurements ought to be entirely re-cast. For instance, 6 inches seemed to be far too long for the average length of the mandible in this country. He thought that word of warning might be useful to anyone who was thinking of making a Salzmann Maxillator.

Mrs. Michaelis thanked Mr. Pringle for his very interesting paper and said she thought it must have made some of the members suffer from nostalgia.

With regard to the question of post-graduate teaching, she would like to know whether in the United States short concentrated orthodontic courses, separate from the universities, were still held, or whether they had been abandoned in favour of a university post-graduate training.

With reference to the serial models of Dr. Sillman's, like Miss Clinch she had been struck by the fact that there were no gross malocclusions, and she wondered whether the cases had been selected from families known to have good occlusion or whether they had been taken absolutely at random. It was rather strange that there were not any congenital malocclusions and that all the malocclusions could be attributed to local causes.

Mr. R. Cutler said he thought all the members would be grateful to Mr. Pringle for his paper.

When Mr. Pringle began with a story, he thought he was going to repeat the one related of Mr. Bernard Shaw when he went to America and was interviewed by reporters on Ellis Island. They asked him what he thought of America, and he replied that the further west he went the more convinced he became that the Wise men came from the East !

Mr. Pringle unquestionably not only had done himself good by going to America but would also do his own hospital good and had done the Society good on the present occasion. One realised, that as a result of the hospitality which he had received while he was abroad, Mr. Pringle must feel rather hamstrung in the matter of recounting to the meeting some of the less favourable features that he might have noticed while he was away. The members could fully understand and appreciate that, and in some private talks with them he might tell them a little more.

The members might have liked to hear from Mr. Pringle more personal details of what he had noticed about the teeth of say, the average taxi driver or bellhop in America, and particularly what opportunity a parent in an American small town, with one or two children with some dental irregularity, had of obtaining a systemised course of orthodontic treatment for them, if he could spend the dollar equivalent of £25 or £50 on that treatment. The members could then compare with that the opportunity which a parent in a similar position in this country had. He thought that was a very important point. The members knew quite well the type of orthodontic service which they could command in this country if they could spend £50 or £100 upon it, and he would like to know whether Mr. Pringle could give the meeting, even if off the record, some idea of what was available in America in that respect.

He had often been greatly intrigued by the extraordinary difference in general outlook and lines of treatment in this country and abroad. In some respects the difference was understandable. The average American came from virile stock, and probably the jaws of the average American child at the present day had greater potentialities for growth than had the jaws of the average child in this country. That did not explain entirely, however, the difference in the general outlook and technical approach which seemed to be common in America as compared with this country. That had long been a source of some puzzlement to him until during the war period he had been civilian consultant to the American Naval Attache in London. He had then come into very close contact, for a period of three years, with many officers of the American Naval Dental Service, and through that contact he had come to realise how the difference in outlook had arisen. The officers seemed to be amazed that he had any knowledge at all of advanced conservative procedure and invariably took it for granted that he must have had some American training ! He did not know to this day what factor was common to himself and to these people on whom he had attended, but there must have been some common factor to give rise to the suggestion that he had had some American training. The point which had impressed him most was the boundless optimism which all Americans had and which was reflected, of course, in their treatment. He thought that optimism was entirely due to their national background. Europeans had been reared for centuries against a background of pogroms, wars and sufferings of one sort and another, and they had developed a much more pessimistic or perhaps more cautious approach to matters in general than that of the Americans. It might be that those sufferings and experiences had inspired many of the artistic developments which seemed to be common to Europeans in music, art, literature and so on and what Aristotle described as " a catharsis of the bowels in a spirit of pity and terror " may well have been the starting point in much of European creative culture. The freedom and abounding prosperity of the Americans had perhaps tended towards a benevolent, but perhaps slightly materialist philosophy, and in the field of orthodontics a characteristic optimism, and abundance of technical expertise could not but secure striking results. What the long term results were he did not know and perhaps Mr. Pringle could say something about them.

Bearing in mind the American outlook, one could understand that American orthodontists regarded British orthodontists as wallowing in ignorance, whereas the fact was that they had a much more cautious and conservative outlook, which might be looked upon as to their credit, and that much of the research work which had been done in this country had been backed by a thoughtful attitude the results of which might be of great benefit. He also would like to pay personal tribute to Dr. J. H. Sillman, their American colleague and member, not only for the contribution that evening but also for many personal kindnesses accorded to him in the past difficult years.

Mr. K. E. Pringle, in replying to the discussion, suggested that a copy of it should be sent to Dr. Sillman, because he felt sure that Dr. Sillman would be very interested in it.

He would advise Miss Clinch to correspond with Dr. Sillman on the points that she had mentioned.

The question of whether the gum pads were together at birth had arisen and he had heard people who were using anatomical material arguing about that question and saying that the gum pads were together at birth. He thought, however, the question was whether they were physiologically together, and personally he felt rather doubtful about that, though Dr. Sillman was quite definite about it. It was not the taking of bites that had made Dr. Sillman reach that conclusion ; he had come to the conclusion independently of the taking of bites. He said that the actual business of taking impressions was very difficult, and that it must be taken that he had done his best and this was what he found. He also said that in the cases in which it was shown that the gum pads were close together they were in fact probably more open than he had shown. He did not know any other way of taking the bite and he did his best.

As to there being no gross malocclusion in the cases shown, a fact to which both Miss Clinch and Mrs. Michaelis had referred, he thought the cases were special cases. Dr. Sillman had hundreds or thousands of models of infants at birth and certainly hundreds of series, and he had 40 to 50 cases from birth to 10 years of age. It was very remarkable that a private practitioner had been able to produce so many. It meant Dr. Sillman going to the children rather than the children coming to him. He believed that Dr. Sillman spent a day a week in going round chasing the children, and he understood that bribery was necessary and that Dr. Sillman even had to employ detectives to keep in touch with the children.

He had not seen the milling wheel to which Mr. Watkin had referred. Most of the carborundum wheels running on lathes were coarse. He had received a note that day from one of the companies in America which made the lathe with a wheel on either side, one coarse and one fine, to say that that had been a war casualty. It was too expensive to produce, and the company now made only the lathe with a single wheel. Some of them had radiating lines with quite big grooves in them ; they were most useful things and he thought they would save many hours of work.

Mr. Watkin said that was his point. A flat stone became rather clogged up.

Mr. Pringle, continuing, referred to Mr. Gray's question about systematising types of cases and said that he had not seen anything of that kind in America, but he had been thinking about it himself.

With regard to Mr. Stocker's question about the loss of deciduous teeth, he would say that American orthodontists could not teach orthodontists in this country about taking out deciduous molars. English orthodontists could teach American ones in that matter.

With reference to short concentrated courses for orthodontists, to which Mrs. Michaelis had referred, he had mentioned in his paper the course given by Dr. Johnson on the twin arch, and he thought there were others. Dr. Johnson's course was limited to orthodontists, and some of them attended it several times.

As to Mr. Cutler's question about orthodontic treatment for the poor, he had made a number of enquiries on that subject. He had gone to the United States in a Polish boat and people on the boat had learned that he was an orthodontist, but not one of those to whom he had spoken knew what an orthodontist was. He had asked well-to-do fruit farmers in California what the situation was with regard to orthodontic treatment for those who could not pay, and they had replied that there was a caravan which went round and all the children were inspected, but beyond that they did not know of anything. He had made enquiries on the same subject at the Guggenheim dental clinic in New York, which was a very large institution for doing conservative work, and he had been told that there was a certain amount of public orthodontic work done, but the children could go to Columbia University or New York University, and, of course, there was Dr. Salzmann's small clinic in Mount Sinai, but even the school fees charged were about £25 a year.

Everything was on a quite different scale from that in this country, and if people had not got the dollars they did not get the treatment.

With regard to the differences between the United States and this country, it must be realised that the United States was a continent, with many different sorts of people. He had come to appreciate very much the steady work done by orthodontists in England, which was very valuable. That work was matched in the States, but it was not the work that attracted attention. In the early issues of the American Journal of Orthodontics some papers by Dr. Helman had been published which were extremely like the papers published in this country, being very conservative, and that applied to papers by other American orthodontists also.

With regard to the American children, his impression was that many of those whom he saw under treatment were of mid-European extraction and they had much larger jaws than the children in this country. He had seen very few children in America with large numbers of temporary molar extractions, such as were common in this country.

He could understand Mr. Cutler's statement that the American naval dental officers with whom he had come into contact were surprised to find that there was any knowledge of advanced conservative treatment in this country, and he thought it was a rather interesting point of view on their part. They were very insular.

On the motion of the President a vote of thanks was accorded to Mr. Pringle, and the meeting then terminated.

* * * * *

DEMONSTRATION MEETING

DIAGNOSTIC MIRRORS.

C. P. ADAMS, B.D.S.

THE MIRRORS FEATURED in this demonstration do not represent any new discovery or new principle. They are merely an advance on the less efficient hand mirror used hitherto in intra-oral photography.

The details of construction are as follows. The device consists of a symmetrical quadrilateral sheet of mirror held in a metal frame by a spring. A short handle projects from the lower border of the frame.

The mirrors are in two sizes, the larger being $2\frac{1}{8}''$ wide at the top edge, $2\frac{3}{4}''$ wide at the bottom edge and $2\frac{5}{8}''$ long. The smaller is $1\frac{3}{4}'' \times 2\frac{1}{4}'' \times 2''$ (*Fig.* 1). They are cut out of lightwieght "silver sheet," and the edges are smoothed with a fine carborundum stone.

The frames are made of German Silver sheet, folded over at top and bottom borders and a light spring keeps the mirror glass pressed up under the upper fold. A light pressure downwards on the mirror from the top edge releases it from the upper fold of the metal frame, the upper border of the frame is notched to facilitate this movement, and the mirror can be lifted from the frame (*Fig.* 2). The frame is sterilised by boiling and the mirror glasses are put into Dettol.

For Orthodontic use, the mirrors are engraved with two lines at right angles. This is done with a needle on the back of the mirror. A fine line of the silvering is taken off and this shows as a black hair line at the front surface.

To use the mirror, the operator stands in front of the patient, and places the warmed mirror in the mouth with the top edge against the upper back teeth (*Fig.* 3). Good daylight or a bright artificial light should shine over the right shoulder

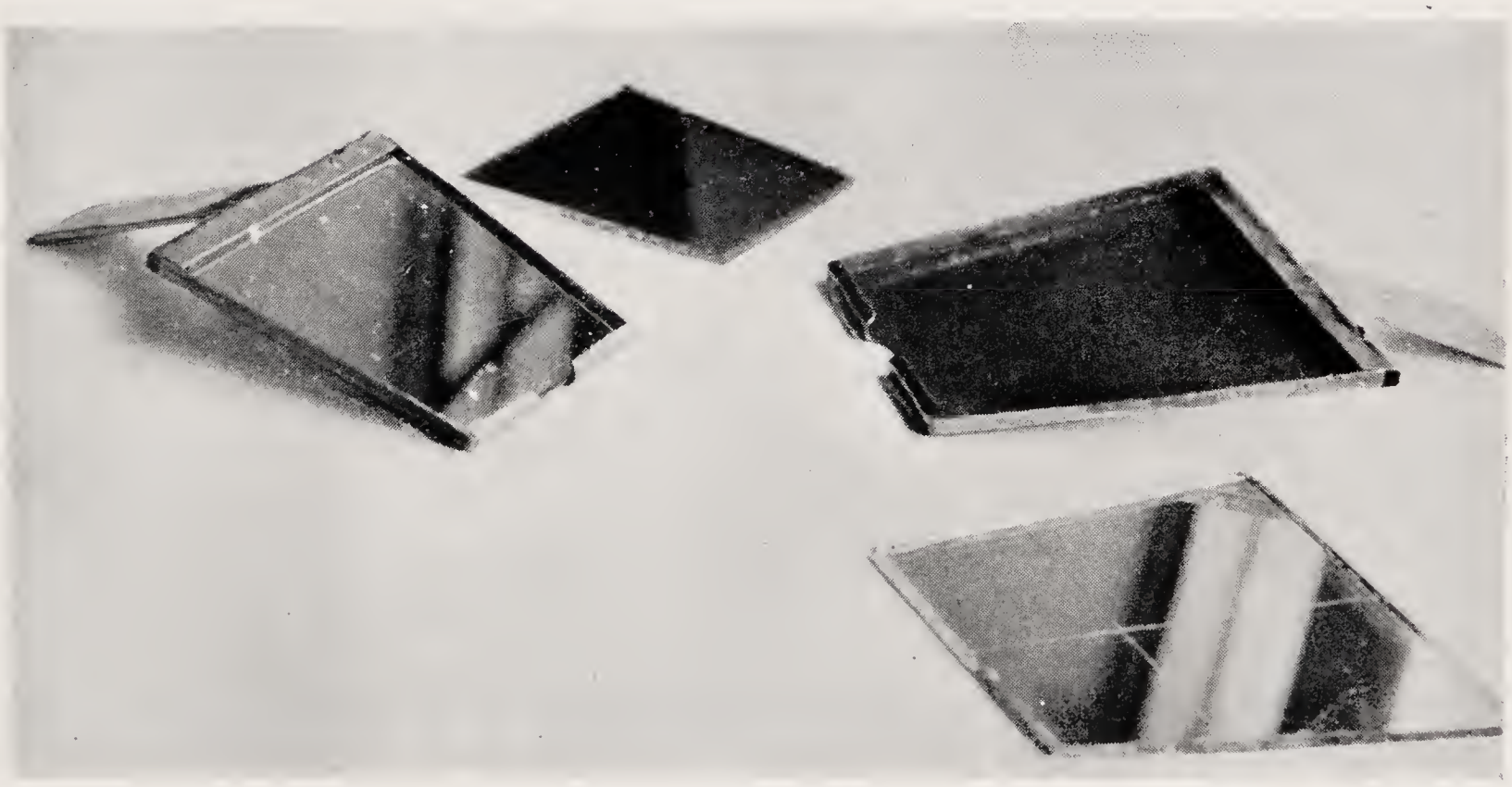

Fig. 1

Fig. 2

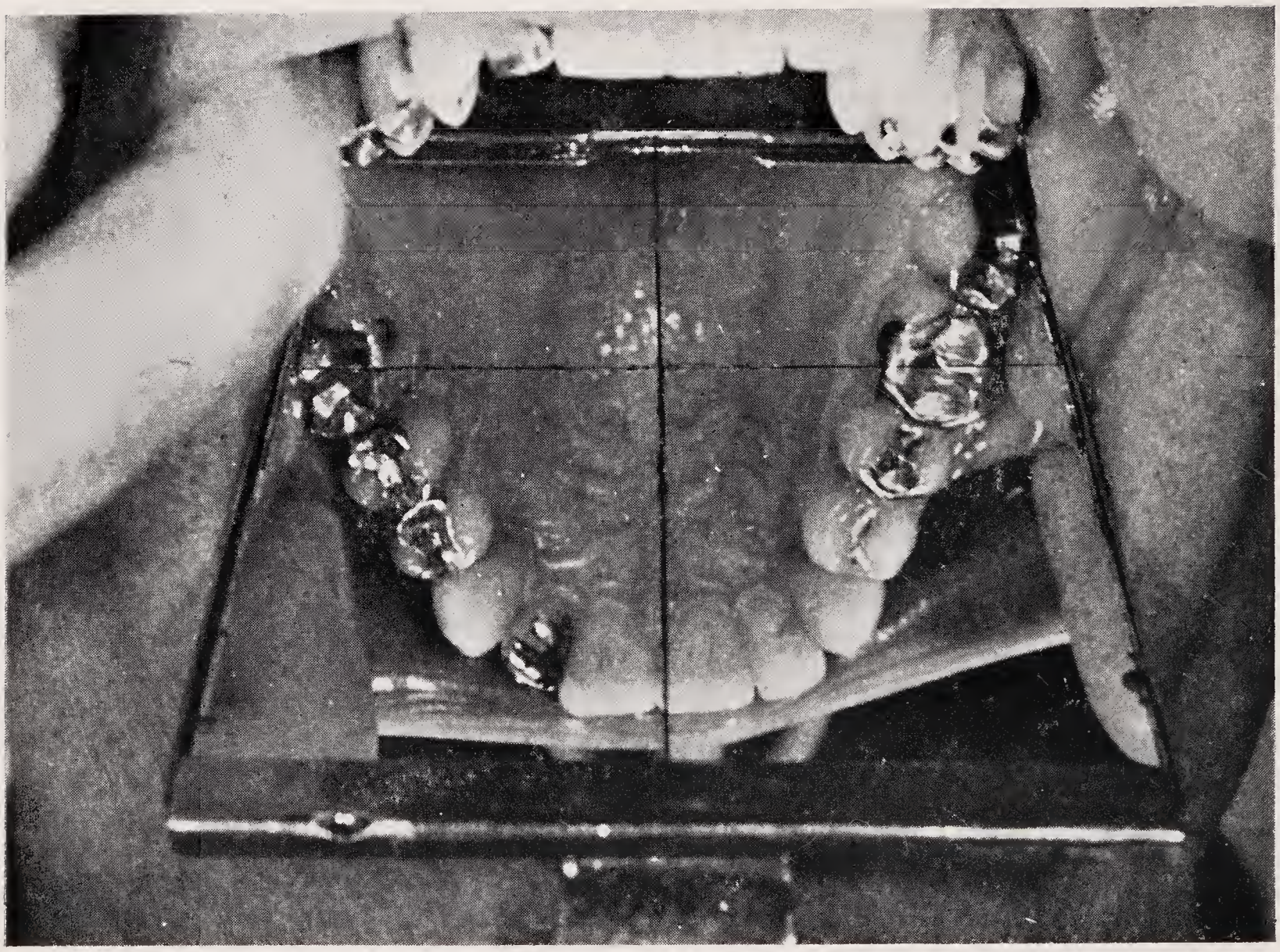

Fig. 3

into the mouth. This gives a well illuminated view of the mouth and upper teeth which may be examined at leisure. The wide lower border of the mirror holds the lips aside and provides a clear view.

In Orthodontic diagnosis the mirror is a great help in examining the upper arch and in assessing its symmetry. When making this examination, it is important firstly to see that the top edge of the mirror is in contact with the back teeth on both sides, otherwise an artificial appearance of assymmetry is produced. One eye is then closed and the vertical registration line is arranged to correspond with the median palatine raphe. Now by referring to the horizontal line any asymmetry of corresponding teeth on opposite sides is at once apparent.

The essential features of the mirror are therefore :—

1. It eliminates strain when examining the upper dental arch and tissues of the roof of the mouth.
2. The symmetry of the upper arch can be more accurately assessed in Orthodontic diagnosis.
3. An extensive and well illuminated view can be obtained for intra-oral photography.

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THE ANODIC POLISHING OF STAINLESS STEEL ORTHODONTIC APPLIANCES.

By G. E. M. HALLETT, F.D.S., H.D.D., L.D.S. (Liv.).

An apparatus was shown comprising essentially of a source of direct current at about 17 volts e.m.f. and capable of supplying up to 6 amp. A mains step down transformer and a selenium dry plate rectifier were used. The cathode was of stainless steel immersed in a bath of:

Phosphoric acid (conc.)	3 parts.
Glycerine	1 part.
Alcohol	1 part.

N.B. The alcohol may be replaced by distilled water without loss of efficiency.

The stainless steel appliance is connected to the anode and immersed in the bath when the current passes at a variable amperage depending partly upon the temperature of the solution, the surface area of the appliance, the distance of the appliance from the cathode. About 5 amperes seems to produce satisfactory results with the average piece. Considerable gassing takes place but this is only hydrogen and no noxious fumes are evolved. In 20 to 30 seconds the appliance becomes brightly polished, weld spots disappear and after a rinse in an alkaline solution it is ready for insertion in the mouth. The polish is lasting and there is less tendency for the wires and bands to attract and hold food material. It is possible that weld decay is reduced. The most delicate contrivances may thus be polished with safety and the avoidance of abrasives. The apparatus is useful also in that it will reduce the diameter of wires according to the length of immersion and the easy sliding fit of bows in tight buccal tubes may easily be effected. The short polishing times of 20 to 30 seconds will not materially affect the diameter of the lighter gauge wires.

The action of the electrolyte is a shearing one, some of the steel actually going into solution, but the precise mechanism does not appear to have been fully worked out yet by the metallurgists. Perchloric acid has been recommended as being more efficient than phosphoric acid, but in view of its explosive properties and the considerable heat which is liable to evolve it is better avoided for dental purposes. Phosphoric acid is both safe and cheap to replace.

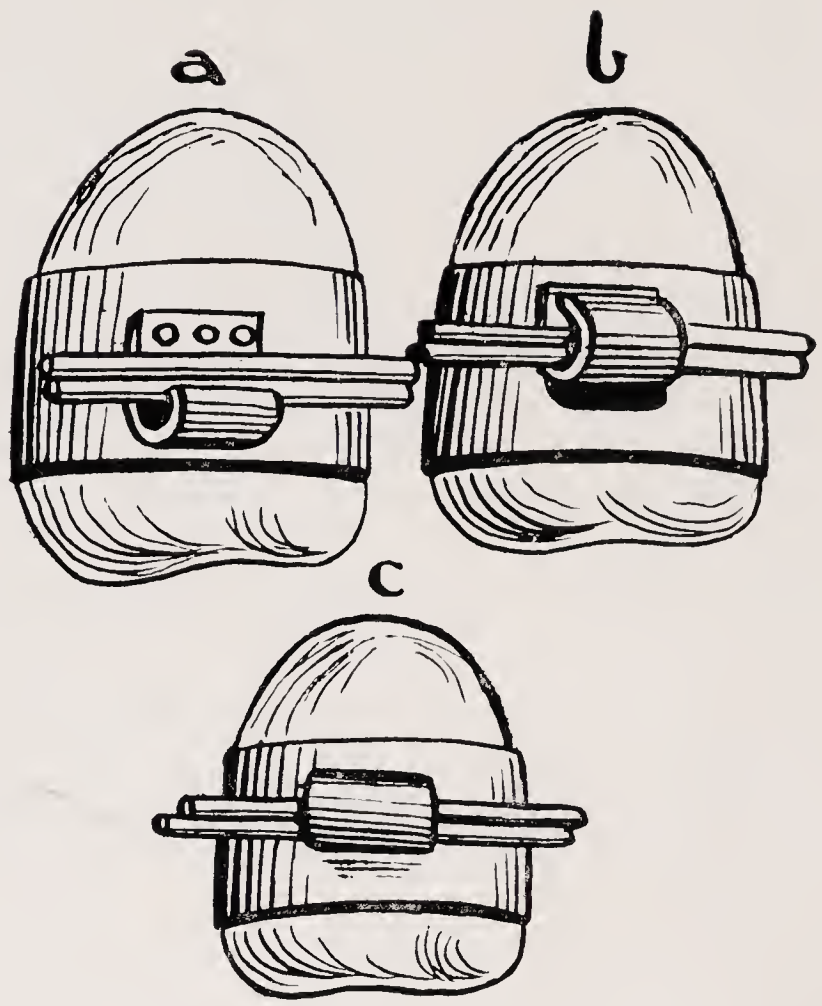
A MODIFIED STRAP-LOCK.

By NORMAN GRAY, H.D.D., L.D.S.

HAVING FOUND A TENDENCY for the Townend channels to open, break or come unwelded, I have found a modified strap-lock largely eliminates this irritating problem. Whilst still holding the arch wire firmly, the lock gives ample scope for the individual tooth movements, and yet is of very simple construction.

The incisor bands are made of 3.0 × 0.15 mm. Stainless Steel tape for the central incisors, and 2.5 × 0.15 for the lateral incisors. These are pliered and contoured in the usual way and fitted to the tooth. A mark is made for the position of the locking strap. A short piece of 2.5 mm. (a) is welded one mm. from the gingival or incisal edge, depending on which way the lock is required for tooth movement, i.e. opening or closing incisal bite.

The strap is welded with the two polished surfaces in contact. The band is again placed on the tooth (b) and the strap curled over the arch wire, the excess being cut away with scissors. The band is removed from the tooth, the strap



straightened out so that the sharp edges may be bevelled. The band is cemented into place (c) and the strap curled over the arch wire and burnished into position.

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A SIMPLE TWIN ARCH TECHNIQUE.

By L. C. MANDEVILLE, L.D.S. (Eng.).

A DEMONSTRATION OF A TWIN ARCH technique using stainless steel materials. The various parts and their preparation were shown in detail. 5 mm. × 0.15 mm. or 0.1 mm. for incisor bands, 3 mm. × 0.2 mm. for incisor attachments, 0.25 mm. hard wire for the twin arch, and 0.9 mm. o/d × 0.5 mm. i/d tube for the " end tubes " of the arch. Accessory coiled springs were made of 0.2 mm. and 0.15 mm. hard wire. Buccal tubes on the molar bands of 0.9 mm. i/d tubing or the Selmer Olsen type were recommended.

The preparation and drawing out of the twin arch was demonstrated and its proper alignment to the incisors by correct positioning of the buccal tubes on the molar bands was stressed. Unintentional elongation or shortening of the incisors might be produced if care was not taken in this alignment. Both these movements could be produced at will when desired by suitable alignment of incisor bands and arch. A twin arch in upper and lower jaws with suitable intermaxillary elastic traction will provide an effective appliance in the treatment of the anterior open bite.

The use of small coiled expansion springs to produce mesial or distal movements of teeth was demonstrated. Such springs can be used to open spaces between teeth, for retraction of canines, and by using the molars as a source of anchorage for the springs to bring about protraction of the incisors in cases of " lingual occlussion " etc.

Models were shown illustrating extreme tooth movement produced by a twin arch in correcting grossly maloccluded incisors.

CASES OF INTEREST AND SOME SIMPLE APPLIANCES

By L. RUSSELL MARSH, F.D.S. R.C.S. (Eng.).

THIS DEMONSTRATION was intended to show how Orthodontic problems may be dealt with by direct simple methods and by simple appliances ; to show the importance of tackling first the fundamental errors of occlusion and arch relationship leaving details of individual tooth movement to a later stage, when it is frequently seen that such correction is no longer necessary ; to show in effect, that if we give Nature a chance she will do her own job.

The writer is of the opinion that the release and correction of the post-normal mandible is of first importance. A number of cases treated with the Andresen (Norwegian) apparatus were shown, all of which clearly demonstrated that the use of the activator combined with muscle exercise can and does effect acceleration of bone growth in the region of the " middle third " of the face.

Examples were shown too of distal movement of the upper buccal segments by means of the Schwarz apparatus in cases of superior protrusion (that is, protrusion of the whole maxillary arch of teeth). In such cases it is found that this distal movement of cheek teeth is effective in raising the bite as happens when the mandible is moved forward. After this correction of the element of superior protrusion in a post-normal case, it is found that ultimate attainment of normal occlusion is very much simplified.

A number of cases were shown which were still in the course of treatment so as to demonstrate clearly the individual steps taken in each case. A number of removable appliances were shown, some with modifications designed by the demonstrators.

It was not, however, intended to suggest that fixed appliances are undesirable or unnecessary, but rather to show what can be done by what we term functional methods and early treatment. There is no doubt that a general practitioner who sees abnormalities in the course of development, if he has some knowledge of Orthodontic principles, can, with or without expert advice, do a lot towards setting Nature upon the right lines, and preventing those gross conditions which are otherwise inevitable. It is surprising, for instance, how often simple expansion of the upper arch at the right time will result in a post-normal mandible assuming its correct relationship, and the use of simple retention appliances after removal of the temporary molars would save the patient and the Orthodontist avoidable complications in the future.

If we are to give service to large numbers of patients our watch word should be, early advice, preventive measures where possible, and simple methods of treatment.

* * * * *

THE CROZAT—O. HENRY REMOVABLE ORTHODONTIC APPLIANCE

By E. STUART SMITH, L.D.S. (Eng.).

THE APPLIANCE consists basically of:—

1. The base wire of 0.50 gauge from molar crib to molar crib conforming to the contour of the palate and being placed so that it gives the least interference to the tongue and avoiding the rugæ. If it is necessary to widen the arch in the molar region the base wire is carried backwards before bending upwards into the palate.

2. The cribbing, made of 0.28 gauge wire is an adaptation of the Jackson crib having in addition at the buccal gingival margin claws or clasps which engage the neck of the tooth. These can be tightened as required.

3. The premolar brace which consists of wires of 0.40 gauge from the palatal aspect of the cribs to the first premolar.

All wires are of Cascowyte soldered on the model with 18 ct. solder .

To this basic appliance springs may be soldered as required.

A high labial arch wire of 0.40 gauge can be soldered to the cribs for the backwards or sideways movement of the incisors by means of finger springs.

A bite-appliance as designed by the late O. Henry can be fixed to the appliance by soldering a wire of 0.38 gauge from premolar to premolar and to which another wire of 0.35 gauge is soldered from the centre to the premolar region as demonstrated. It is not necessary to have a complete arch for the bite wire.

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CASES OF INTEREST

By L. RUSSELL MARSH, L.D.S. R.C.S. (Eng.).

CASE 1

Fig. 1. This case emphasises the dire necessity of X-rays as a preliminary to diagnosis and treatment.

The mother of this child is the original of a case I showed here fifteen years ago, who had absence of both maxillary second premolars together with absence of both maxillary canines. It was apparently a record, for no one had heard of a similar case. Now, twenty years after my first meeting with her, she has brought her daughter to me and this is the situation. I might add that the mother also had one peg-shaped lateral—and on the same side.

I have my work cut out with the second generation, for the centrals are almost horizontal, the lower incisors hard on the palate, the right upper central is dead and purulent, and she still sucks her thumb !

FOOTNOTE—*Mother lost one temporary canine, age* 29 *and one, age* 30. *This is interesting for the text-books say that a persistent temporary canine will remain until about age* 30.

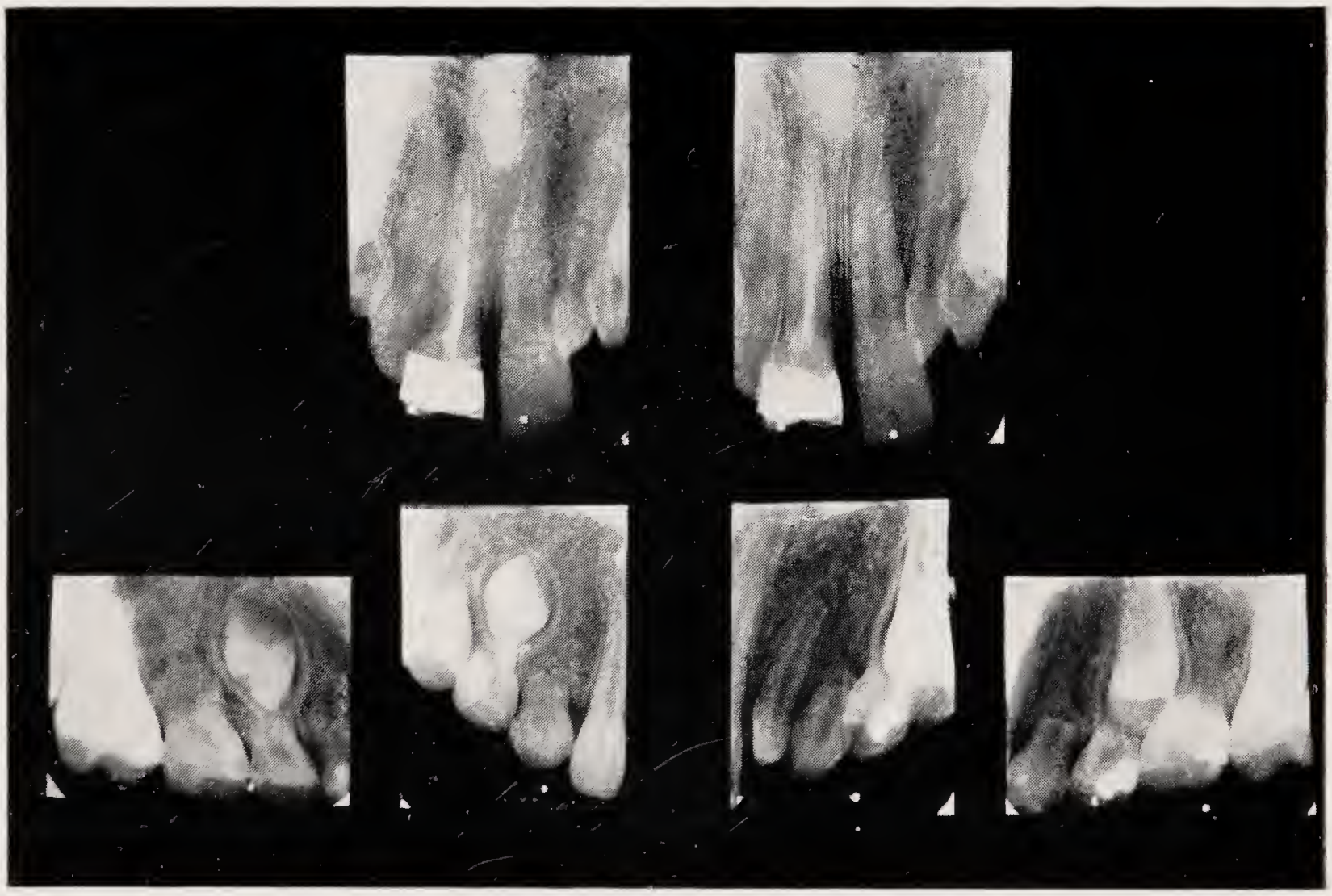


Fig. 1.

CASE 2

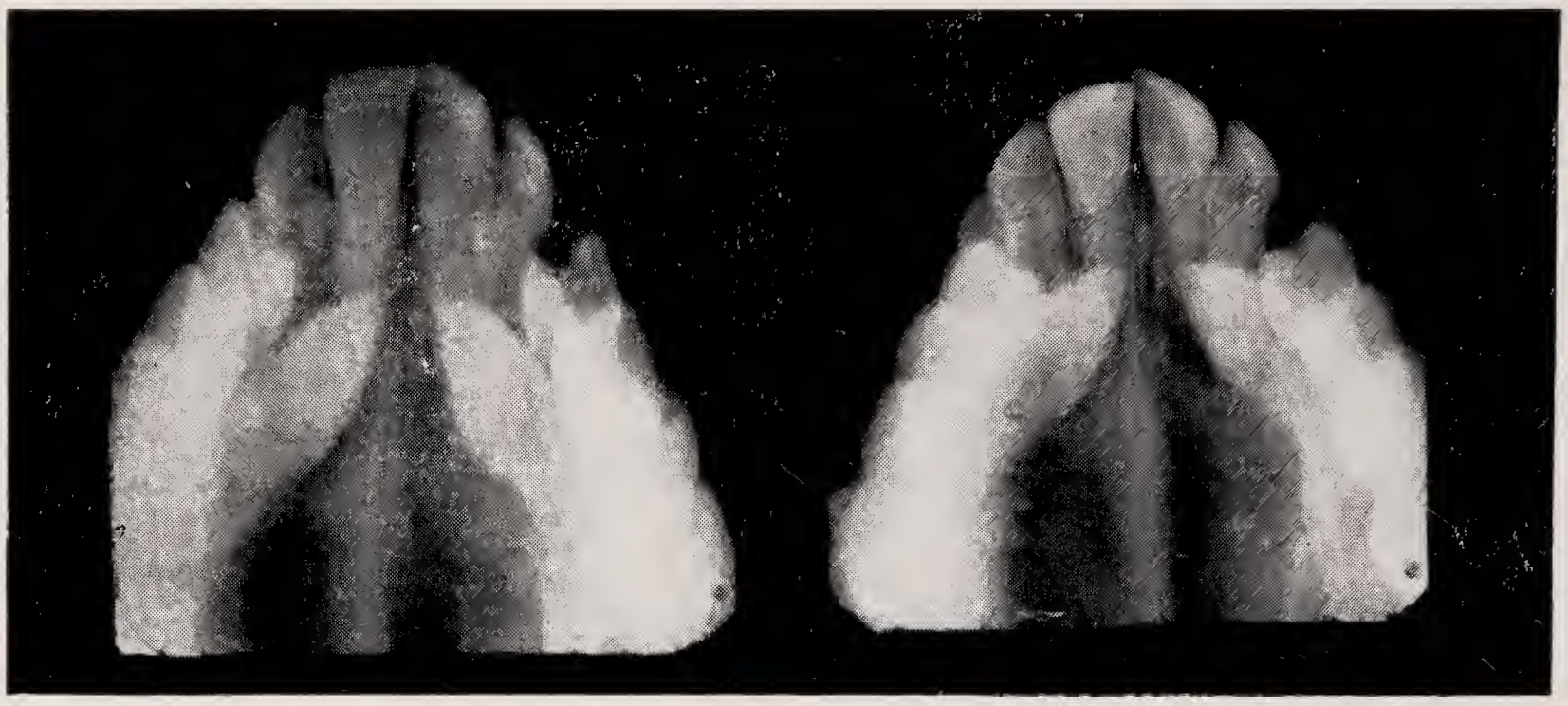


Fig. 1. (*above*)

Another case of canine interest. Both canines were lying horizontally in the palate and very deep, their incisal tips being about the level of the apices of the incisors. I operated and cemented wires into cavities prepared by the Watkin method.

Fig. 2. (*left*)

This shows the progress of the two teeth on their way down into position, and it is interesting to note the path of their apices.

Fig. 3. Models before and after, showing the improvement of the aesthetic factor with increase of width of the arch.

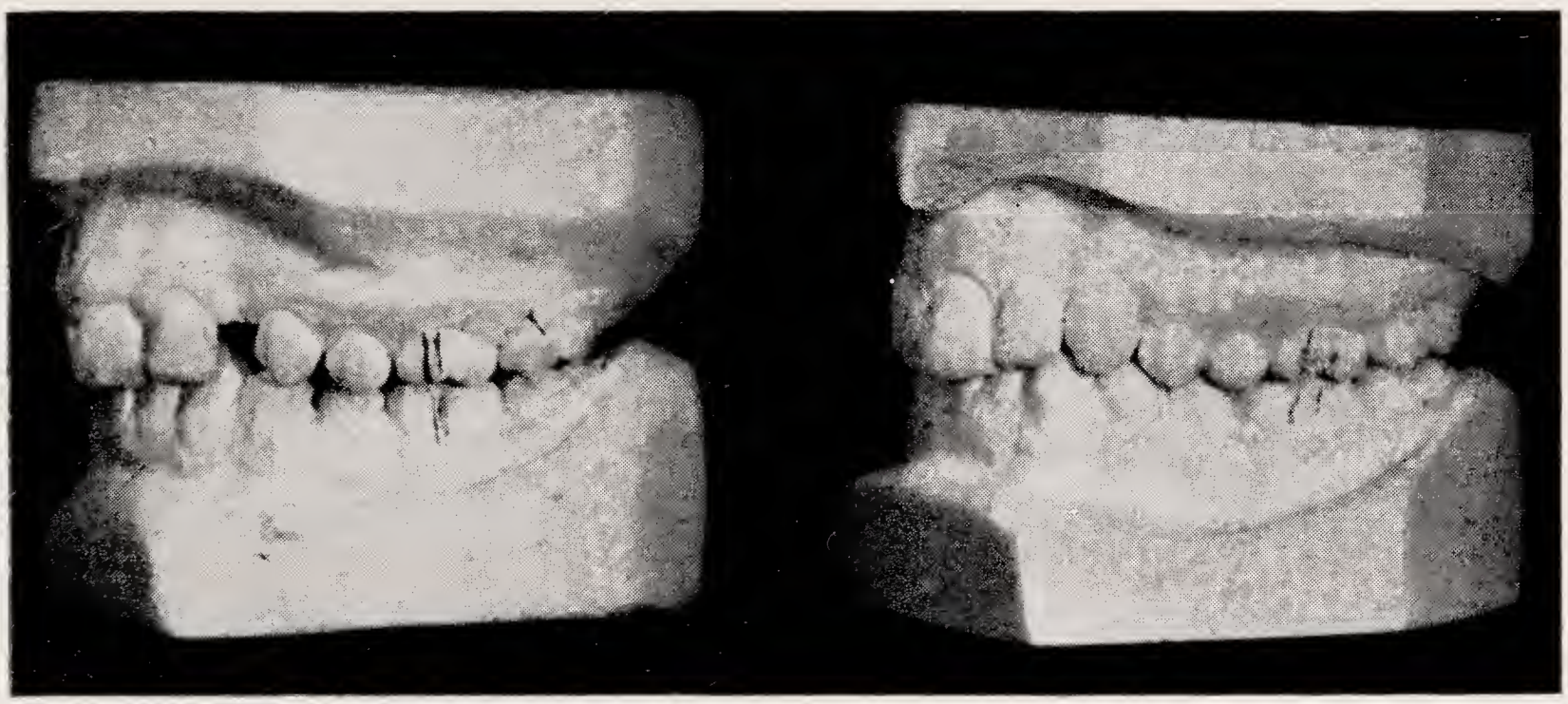


Fig. 4.

Side view. One point I would emphasise is that in my preliminary treatment I made more than sufficient space for the two teeth—nearly twice their width, by moving the buccal segments distally with a Schwarz appliance. This is important.

Before we begin the congratulations there is a less glorious postcript to be added, which is my main reason for showing the case. These teeth were deep and they were stubborn. It was some time before they emerged through the palate tissues, which had been allowed to close over the wires. Before I could get at them the cavities were considerably larger. After removing the wires I dressed them for months, but in spite of my efforts the pulps quietly died, without ever giving pain. When I opened the pulp chambers there was nothing solid to remove. The canals were sterilised and the roots filled. Perhaps this might have been avoided, but I do not quite know how. It is obviously a risk which should be mentioned at the outset.

In another case I am doing, in which the position of the canine is a little more favourable, I have completed the Schwarz stage and have provided ample space. The tooth is now erupting without help.

These cases should be approached with great caution.

CASE 3

Fig. 1. This was a case of absent upper lateral incisors with permanent canines almost touching the centrals, their roots being parallel with those teeth. Buccal A/P occlusion normal. It was decided to open the gaps and bridge with artificial laterals. After moving the canine crowns it occupied a full year to move their apices—the most important part of the whole operation.

Fig. 2.

Lateral view.

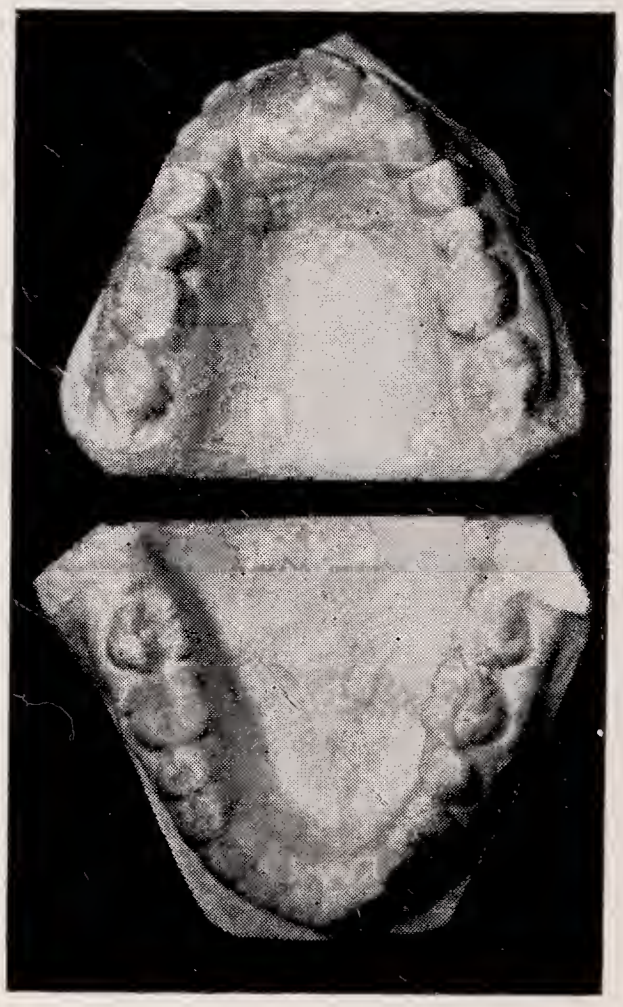
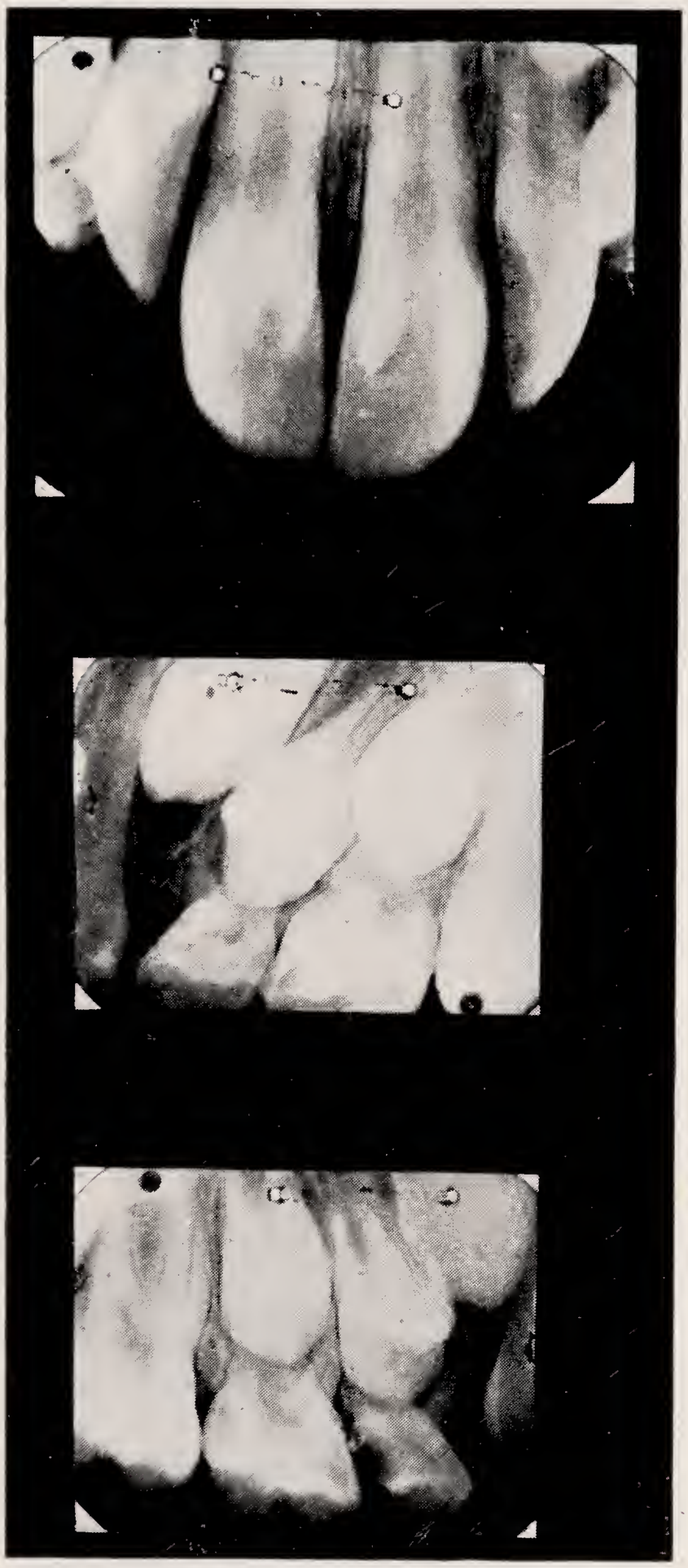


Fig. 3. (*right*)

A single fixed bridge built on three quarter crowns on the canines and carrying artificial lateral incisors, was fitted three months after completion, and has insured retention of these teeth. The Carmichael crowns are shaped like premolars to receive direct vertical pressure from the mandible and *not* oblique pressure.



CASE 4

Fig. 1. (*left*)

This patient had large teeth, the erupting central incisors overlapping—the laterals, as shown by radiographs, rotated through an angle of nearly 90°. A typical case, in my opinion, for serial extractions. It will be seen that the relative positions of the first premolars and canines were just favourable.

Fig. 2. (*below*)

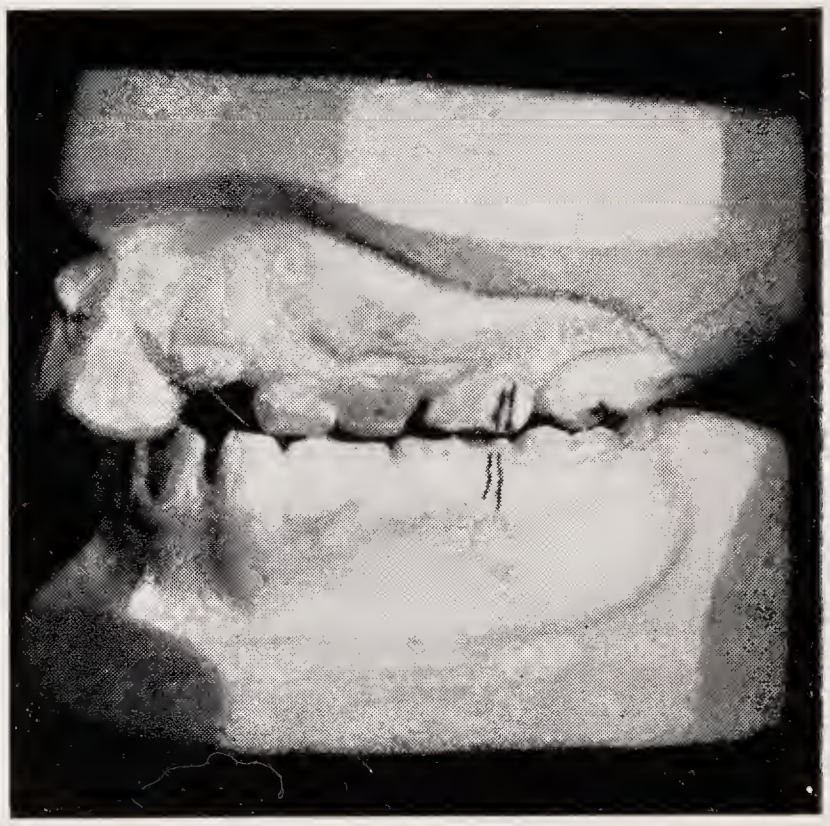
The temporary canines were removed, with the result you see in *Figures* 2 and 3, and in due course the first premolars will be extracted to make room for the erupting canines.

Fig. 3. (CASE 4 *continued*)

The lesson here is that, provided space is made available by one means or another (by no means always by extraction) at the right time, a lot of heartbreaking and often disappointing work with fixed appliances can be avoided.

CASE 5

Fig. 1. *(right)*



This boy, Class I threatening Class II, would have been a similar case but for one complication. Owing to rampant caries he had to lose all his temporary molars and all four first permanent molars. It was not a question of having the courage to remove these teeth—they *had* to be removed. I believe one first molar and one first temporary molar could have been saved.

He was left with six anterior teeth upper and lower, of which the four canines were temporary.

There is only one appliance which could be of any use in a case of this kind. I gave him six months rest and then put in an Andresen (Norwegian) activator, to restore some function—absent through the loss of teeth—and to help guide the new teeth down into position. I have seen him every two or three months to adjust and modify the appliance, which was renewed once.

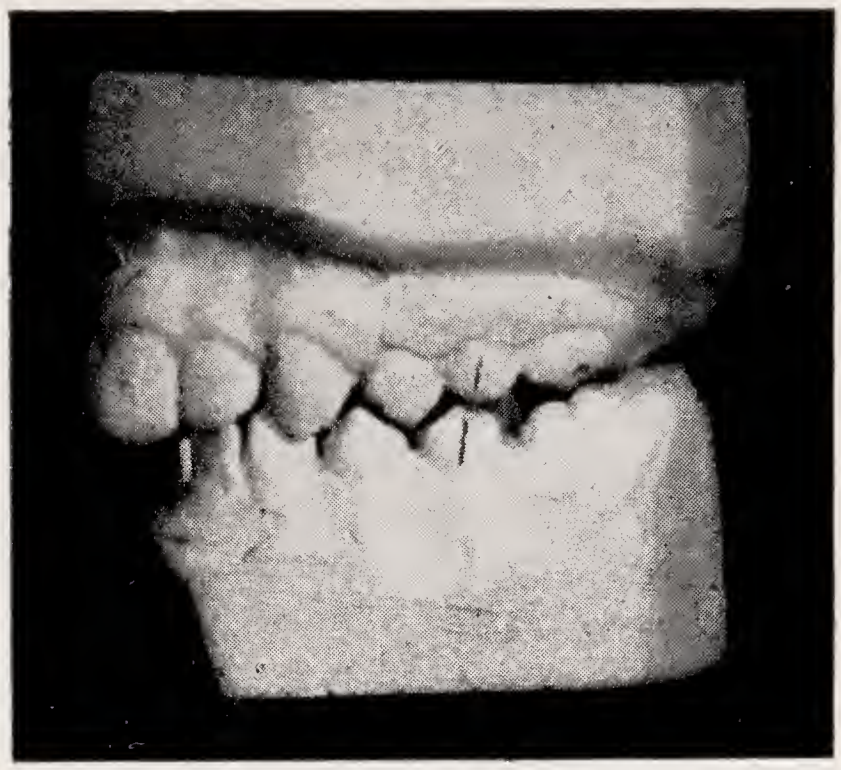


Fig. 2. CASE 5 (*continued*)

These recent models show the cheek teeth, premolars and second molars, coming down into correct relative positions—and I have not yet begun active orthodontic treatment.

* * * * *

DISCUSSION

The President said that the members were very grateful to Mr. Marsh for showing them such very practical cases, very pithily described.

In regard to the case in which the pulp of the canine teeth died, he would like to know why it died, Had it been due to caries ? The dentine in such very young teeth was very permeable.

Mr. L. Levien, referring to Mr. Marsh's remark that he did not know how to avoid the pulp dying, said that a method which he had employed for many years was to put a very thin gold cap on the crown of the tooth, with a little hook on it, instead of drilling into the tooth. That could be done quite easily. When he had dug the crown clear and removed some bone he got a clear view of the crown, and he then packed it for a few days either with gutta-percha or with zinc oxide. He could then get an impression of the crown of the tooth and he made a cap and cemented it on. It stayed on very tightly indeed. He then did the work in the usual way.

Mr. H. Chapman said that in one case described by Mr. Marsh the lateral was shown in one slide to be overlying the central very much and in the next slide it was shown to be in an excellent position. He would like to know whether the lateral had moved naturally or whether Mr. Marsh had used an appliance to move it.

Mr. H. Watkin said that he was very interested indeed in Mr. Marsh's communication. It reminded of him a similar case which he had had, in which one of the canines was impacted on to the root of the central and three parts of the root of the central were absorbed. The central was loose. He extracted it and brought the canine down and eventually ground the tip of the canine. It was difficult now to tell that anything had happened. He thought that stress ought to be laid on such cases. It was most important that something should be done about them, as if they were left alone it was very difficult for the patient.

Mr. L. Russell Marsh, in replying to the discussion, said that the teeth in the case in question had been too deeply in the tissues for the ordinary capping to be done. If they were near enough to the surface he did it, but in this case it would not have been possible to expose the teeth and let them remain exposed. They had been quarter of an inch from the surface tissue. Therefore it had been necesary for him to use the wire attachment method. He had seen cases in which a cavity had

occurred in the root of a tooth well underneath the bone level and the root had absorbed until the pulp had been invaded and the patient had had toothache, and he had had to extract the tooth.

With regard to the death of the pulp, to which the President had referred, he did not know whether it had been due to ordinary caries or not. In a case in which one operated and drilled the cavity one introduced saliva, so there might have been ordinary caries, but the pulp had died before the teeth actually erupted. The cement was half dissolved. The wire was not detached ; it was caught in a cavity in a special way and it was rocking. It was not cemented in before the teeth were right through. When they came through sufficiently for him to take the wire away and dress them, there were quite enormous holes in the teeth.

In the case to which Mr. Chapman had referred, the teeth had come down quite naturally without any help. He thought that he had put in a retaining appliance to keep the temporary molars from coming forward, but he thought he had been unnecessarily cautious in doing that. He had not done anything at all to move the teeth.

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THE DEVELOPMENT & GROWTH OF THE UPPER JAW

By JAMES H. SCOTT, M.D., L.D.S.

SINCE THE TIME OF JOHN HUNTER MANY methods have been used in the attempt to work out the problems involved in the complex process of facial growth. These methods include madder feeding, microscopical examination for evidence of bone cell activity and the insertion of wire rings into the jaws of animals. In this experimental work the most popular animal has been the pig. In the investigation of the growth of the human face the methods most used have been the superimposition of outline drawings along various selected planes, a similar treatment for individual bones, the use of various facial measurements taken from the living body and, more recently, the use of X-rays. The advantage of the two latter methods is that the same individual can be examined at different periods of development, the disadvantage lies in the obvious inability to take the part to pieces.

The present teaching on the growth of the maxilla and the upper face is based largely on the work of Keith and Campion and it is, in brief, that the greatest growth of the maxilla in the antero-posterior direction is at the back of the bone and that the permanent molar teeth come into position without there being any forward movement of the teeth through the alveolar process. At the same time, it is held, the maxillary antrum extends backwards as the maxilla develops. As a result of these growth changes it is postulated that the maxilla as a whole is thrust forwards and downwards away from the base of the cranial portion of the skull. This teaching was put forward by Keith [1] as early as 1902 in the following words "The body of the bone (the sphenoid), the anterior border of its great wing and its pterygoid process forms the fulcrum on which the growth of the upper jaw takes place.... the postero-superior angle of the maxillary sinus forming the anterior boundary of the spheno-maxillary fossa, may be regarded for the purposes of representation as a fixed point in the growth of the upper jaw, from this point the rest of the jaw is thrust away from the spheno-maxillary fossa by the development and growth of the maxillary sinus."

Brodie [2] wrote in 1941 "....in the upper jaw the same growth posteriorly takes place at the tuberosity. The latter buttressed as it is against the pterygoid process of the sphenoid, leads to a forward positioning of the maxilla." and in 1948 "The growth that takes place at this site (the fronto-maxillary suture) seems to be localised largely on the maxillary side. There we gain the impression that this bone by growing upwards against a fixed base, is pushed downwards. But the maxilla forms the major portion of the floors of both nasal cavity and orbits, neither of which descend as fast as does the entire bone. A similar rate of descent would maintain the infantile proportions of these

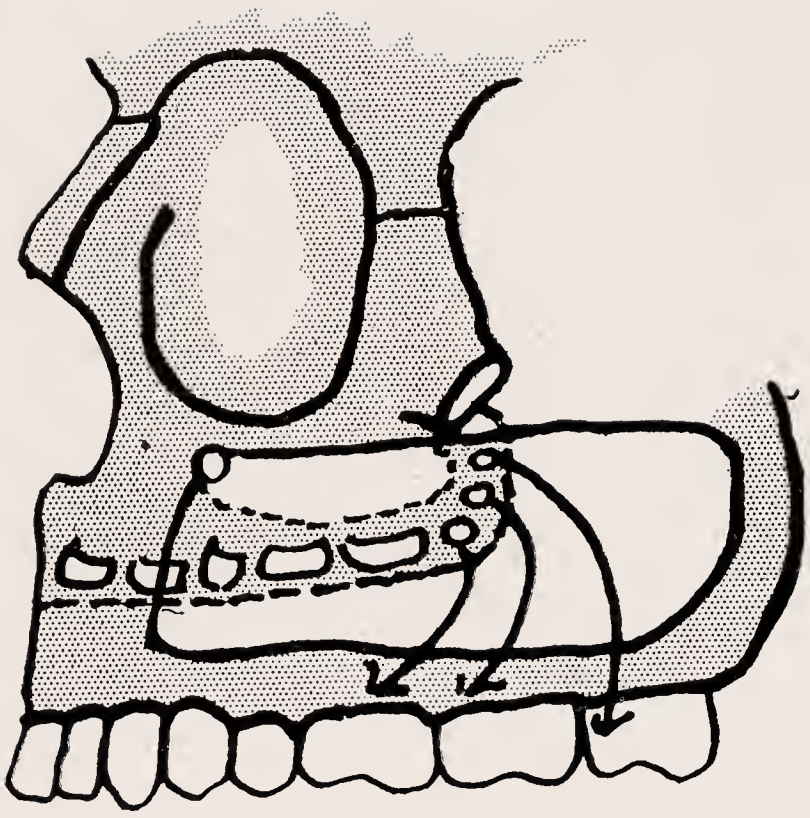

Figure 1. *Keith's conception of the growth of the maxilla and antrum and the method whereby space is made at the back of the maxilla for the permanent molar teeth.*

parts which are large at birth. To prevent their over enlargement new bone is laid on the superior surface of the floors of the nasal cavity and the orbits and in this manner the adult proportions of the face are achieved."

Salzmann[4] supports the same thesis when he states " Growth of the maxilla downwards and forwards takes place mainly at the fronto-maxillary suture, at both ends of the zygomatic bone. . . . and at the pterygo-palatine suture between the pterygoid process of the sphenoid and the vertical process of the palate bone."

This predominant idea of a ' thrusting downwards and forwards ' of the maxilla is based on the belief that most of its growth takes place at the back of the bone and at the fronto-maxillary suture and this belief in turn is based historically on the belief which goes back to John Hunter, that the teeth do not move forwards in the alveolar bone after their eruption. Keith[5] himself, however, had some doubts on this ancient doctrine of the fixity of the teeth in the alveolar bone for he wrote " These calculations are based on the belief, by no means well supported, that there is no forward migratory movement of the mandibular alveolar element, the element which carries the mandibular teeth, but that the buds of the premolar teeth rise up and occupy the same relative position in the mandible as the milk molars did in the young adult." *See fig.* 7.

Furthermore this teaching of the nature of facial growth involves certain assumptions as to the nature of suture growth which are not, I believe, borne out by the facts.

Since the pioneer work of Keith and Campion, however, Brash[6] by the use of madder feeding methods and Friel[7] by the analysis of malocclusions, have brought forward convincing evidence that the teeth do in fact move through the alveolar bone and their work leaves the whole question of facial growth open to further investigation. In this paper I hope to bring forward further evidence of a forward migration of the whole dentition during the period of growth of the face and to suggest certain modifications in the current teaching on facial growth.

Cranial and Facial Suture Systems

We shall turn first to a general analysis of the chief suture systems of the human skull. The cranial part of the skull can be divided by two great suture systems into three principal segments :—

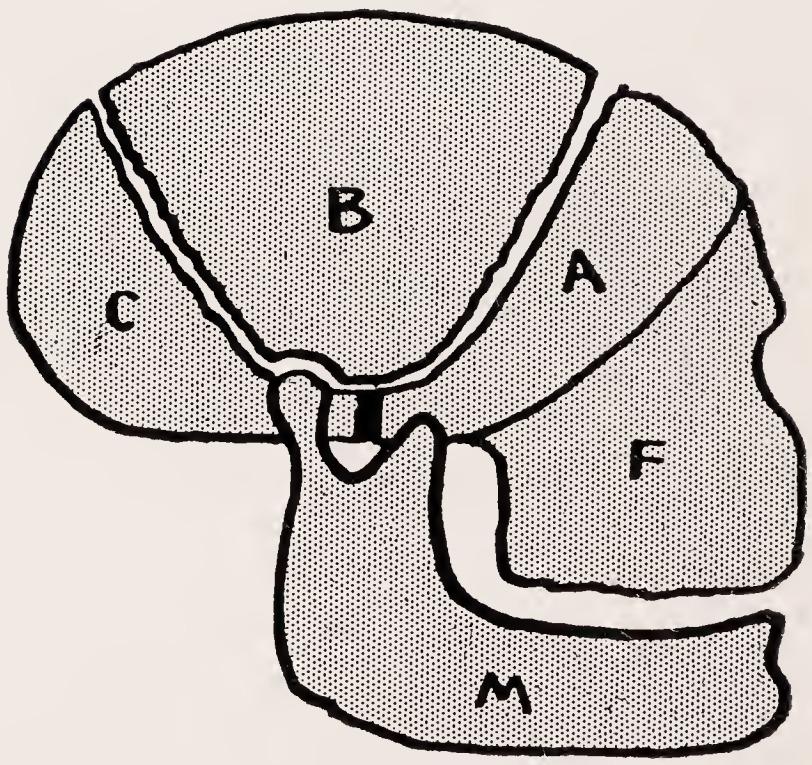

Figure 2. *A diagramatic representation of the cranial segments and their relation to the upper and lower portions of the face.*
A. *the anterior cranial segment.* B *the middle cranial segment.* C. *the posterior cranial segment.* F. *the upper portion of the face.* M. *the lower jaw.*

1. An anterior segment, in front of the coronary suture system, made up of the frontal, ethmoid and sphenoid bones and carrying the upper part of the face. This segment lies in front of the important synchondrosis at the base of the skull between the basi-occipital and basi-sphenoid bones ; it carries with it the pituitary fossa and the ' registration point ' of the Broadbent technique.
2. A posterior segment, made up of the occipital bone and carrying the foramen magnum at which the vertebral column is attached to the base of the skull.
3. A middle segment, made up of the parietal and temporal bones and which is associated, at the temporo-mandibular joint, with the lower jaw.

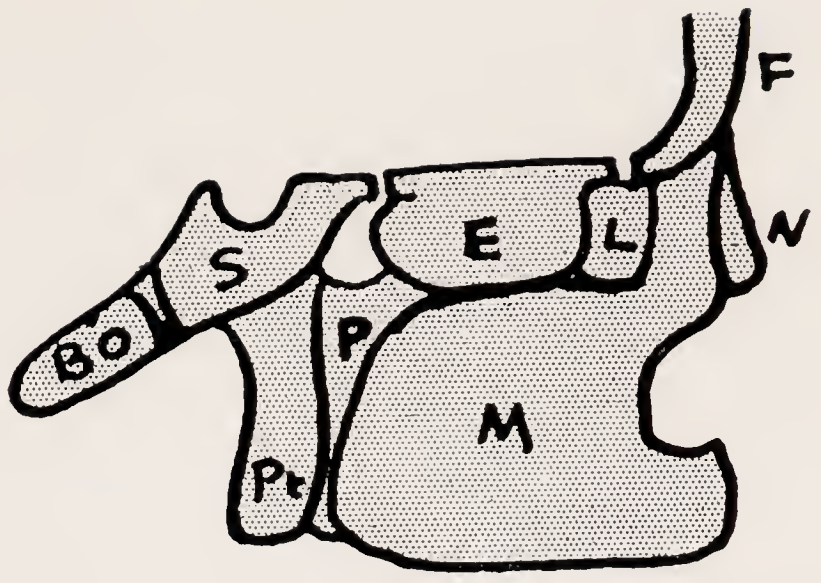

Figure 4. The relation of the maxilla to the other bones of the face and the cranial base in man.
M. *maxilla.* N. *nasal bone.* F. *frontal bone.* L. *lachrymal bone.* E. *ethmoid.* P. *vertical plate of palatine bone.* S. *body of the sphenoid.* Pt. *pterygoid plate.* B.O. *basi-occipital.*

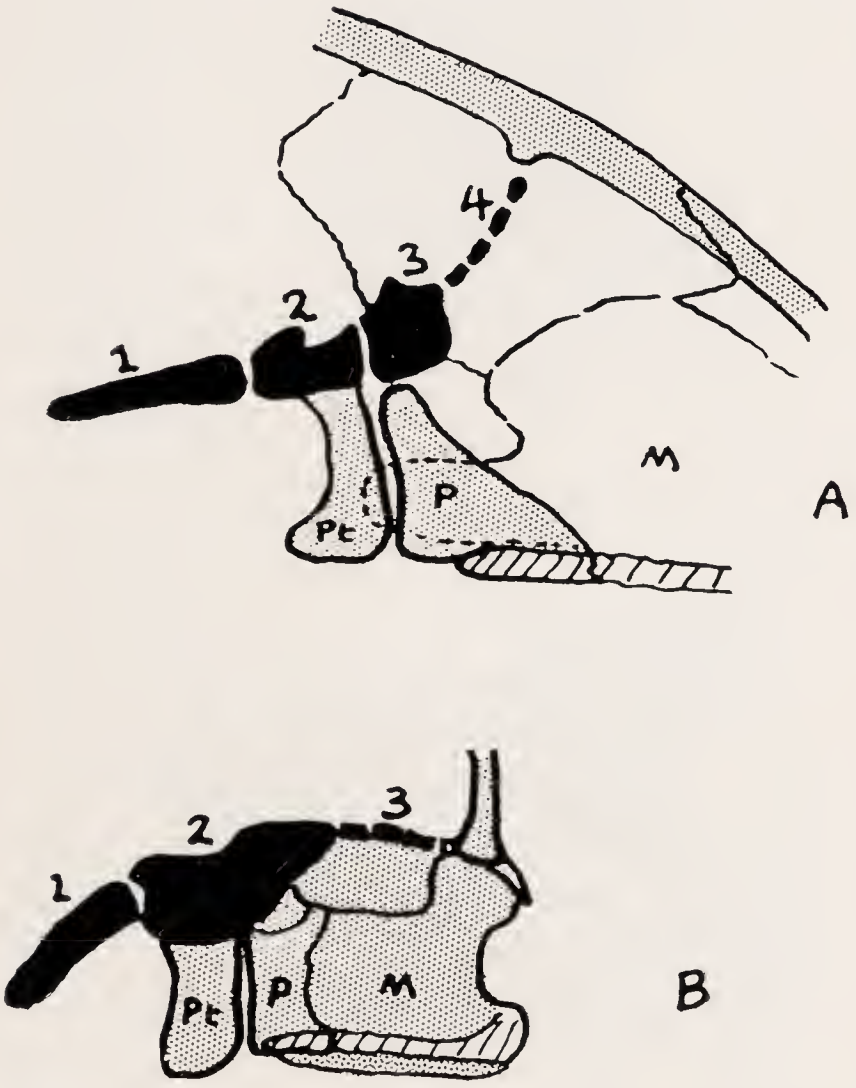

Figure 3. Mid-line sagittal section through the cranial base of the Pig (A) and Man (B).
Pig :— 1. *basi-occipital.* 2. *post-sphenoid.* 3. *pre-sphenoid.* 4. *ethmoid.* M. *Maxilla.* P. *palatine bone.* Pt. *median pterygoid plate.*
Man :— 1. *basi-occipital.* 2. *sphenoid.* 3. *ethmoid.* M.P. and Pt. *as above.*

Growth at the basal synchondrosis between the occipital and sphenoid bones, which is similar in all respects to the growth of an epiphyseal plate in a long bone, will thrust the anterior segment forwards and the posterior segment backwards. As however the posterior segment is attached to the vertebral column, growth at the synchondrosis will be transmitted into a general forward growth of the whole skull. The middle segment will continue to grow between the anterior and posterior segments until about the seventh year by which time the petrous portion of the temporal bone reaches adult size.

The Anterior Cranial Segment

In taking the anterior cranial segment to include the sphenoid I am diverging somewhat from the usual practice which is to limit the anterior segment to the frontal and ethmoid bones and to include the sphenoid in the middle segment so that the spheno-ethmoidal suture at the base of the skull is taken as the growing area which separates the anterior and middle cranial segments. This difference in interpretation is of some importance in the anyalsis of facial growth for the following reasons :-

1. If the sphenoid is not included in the anterior cranial segment, and the spheno-ethmoidal suture is taken as an important growing region, the upper face becomes

divided into two portions, an anterior consisting chiefly of the maxilla and palatine bones, and a posterior consisting of the pterygoid plates. If this be so, then the suture between these parts will also become an important growing region. Keith[5] attached great importance to the spheno-ethmoidal suture and wrote "Our chief interest in the spheno-ethmoidal suture is because it is concerned in providing space for the erupting molar teeth." The question therefore resolves itself into one as to whether the most important limb of the coronal suture passes in front of or behind the great wing of the sphenoid bone below the level of the pterion. I believe that after the second year the posterior limb of the suture which passes behind the sphenoid is the more important in the growth of the cranial base.

2. It is well known that the front of the cranial base is bent downwards on the basi-cranial axis and since 1867 at least the bending has been taken to occur at the spheno-ethmoidal suture. T. H. Huxley[8] in an article appearing in the first number of the Journal of Anatomy and Physiology defined the basi-cranial axis as "a line drawn through the middle vertical plane of the basi-occipital, basi-sphenoid and presphenoid, from the hinder extremity of the former bone to the anterior extremity of the last at the upper border of the ethmo-presphenoid (spheno-ethmoidal) suture." and he went on to show that rotation of the frontal region of the skull around the front end of the axis is an important factor in the development of facial prognathism. "The face remaining the same, prognathism may be indefinitely increased, or diminished, by the rotation of the frontal region of the skull, backwards or forwards, upon the anterior end of the basi-cranial axis." From a study of foetal, infant and adult skulls I am convinced that there is no bending or

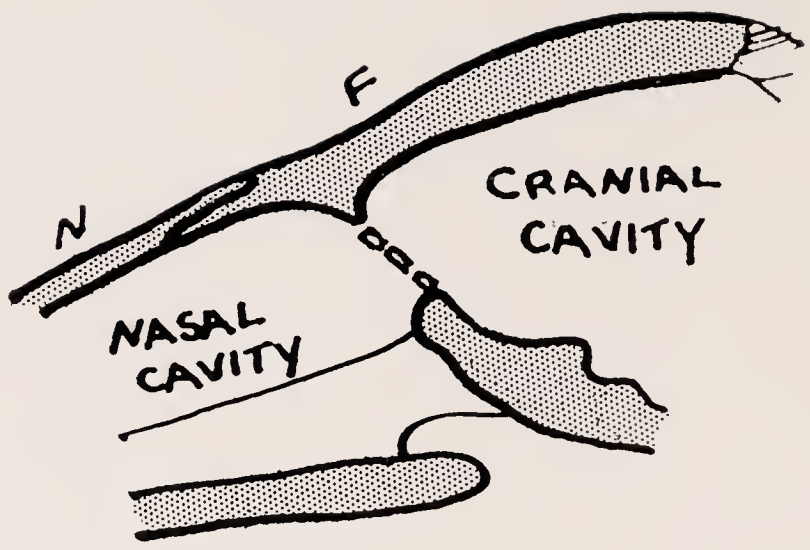

Figure 5. *Sagittal section through the cranial and nasal cavities of a Pig to show the position of the fronto-nasal suture and its relationship to the cranial and nasal cavities.*

F. *frontal bone.* N. *nasal bone.*

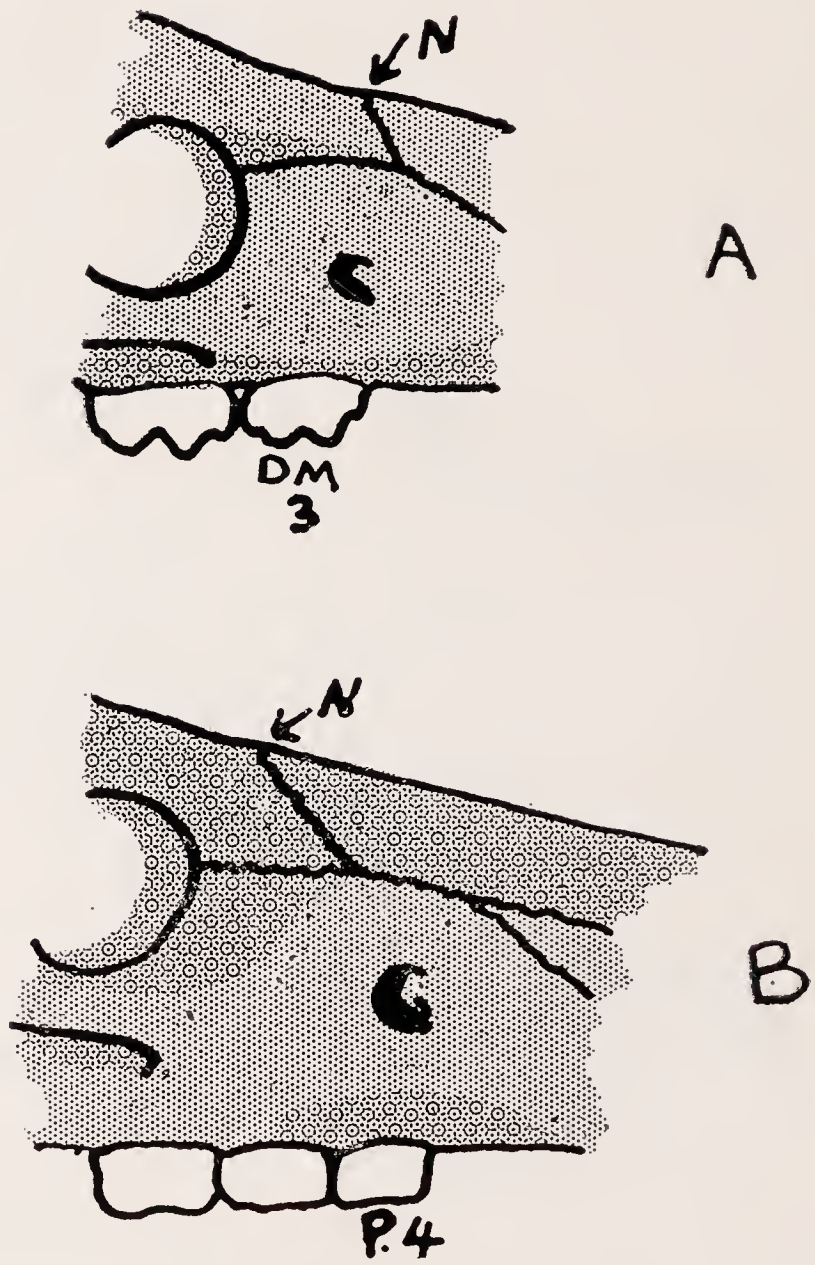

Figure 6. *Side view of the face of a new born pig* (A) *and of an adult animal* (B) *to show the relative position of the nasion* (N), *the infraorbital foramen and the third deciduous molar and the fourth premolar.*

rotation of the cranial base at the spheno-ethmoidal suture during development but that these changes take place at the spheno-occipital synchondrosis. If this latter view is correct then there takes place a swinging downwards and backwards of the whole face, including the body of the sphenoid and the pterygoid plates during development. If however this bending took place at the spheno-ethmoidal suture the tuberosity of the maxilla would be carried against, and would have to be thrust away from, the palato-pterygoid buttress. This latter is the current teaching on this matter.

The Cranial Base in Man and in the Pig

In the post-natal human skull the cranial base is made up of the three bones, the basi-occipital, the sphenoid and the ethmoid, along the middle line. The most important suture is that between the basi-occipital and the sphenoid from which the anterior cranial segment carrying with it the whole of the upper face is carried forwards from the posterior segment. In the pig the cranial base is made up during the period of skull growth of four separate bones, the basi-occipital, the post sphenoid (which carries the pterygoid plates), the presphenoid, and the ethmoid. The two important sutures both of which grow by the conversion of cartilage into bone, are those between the basi-occipital and post-sphenoid and between the post-sphenoid and the presphenoid. Growth at the latter, which is absent in the human skull after birth, will carry the front part of the upper face away from the pterygoid plates so that in the pig, unlike the human skull, the suture between the palatine bone and the pterygoid plates is of importance in facial growth for as long as growth takes place at the cranial base.

Facial Suture Systems

The upper part of the face cannot be taken as a single unit with a uniform pattern of growth in all its parts. It consists of three quite distinct regions, the orbital, the nasal and the oral, and each of these, associated with quite distinct organs, grows in a different manner from the others. The maxilla is involved in the growth of all three regions so that we expect to find that different parts of this bone have their own individual growth pattern. This could not be brought about by growth at the sutures which separate the maxilla from adjacent bones but only by variations in the amount of bone deposited and absorbed on the various surfaces of the bone. The facial sutures fall into the following systems:—

1. The suture between the maxilla and premaxilla (the anterior facial suture system).
2. The suture system between the maxilla on the one side and the frontal, lachrymal, zygomatic, ethmoid and palatine bones on the other side (the posterior facial system).
3. The suture between the lachrymal, ethmoid and palatine bones on the one side and the frontal and sphenoid on the other (the posterior facial system).

In a general way the two latter systems have a direction parallel to one another but in the human skull, unlike that of other mammals, both systems consist of a posterior vertical segment related to the spheno-maxillary (pterygo-palatine) fossa and an anterior, horizontal, segment

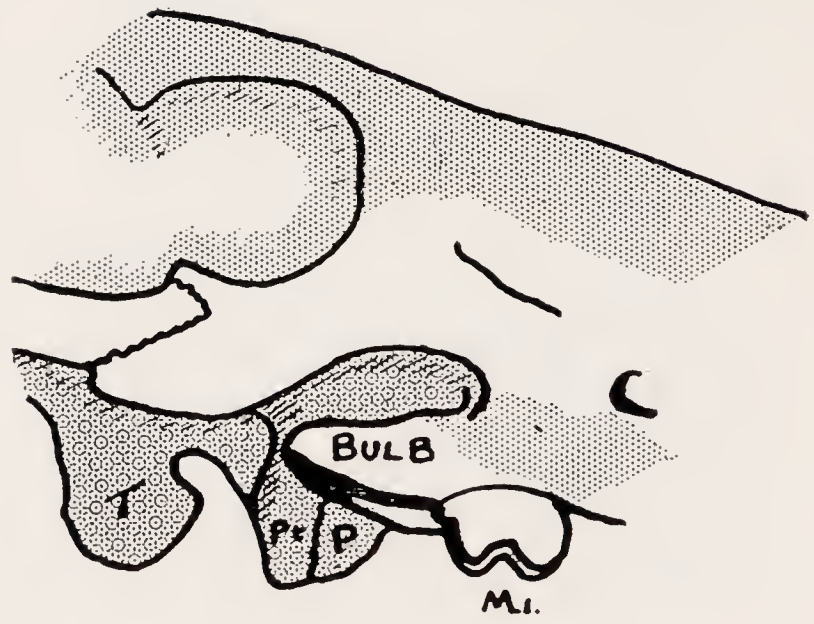

Figure 7. A diagram to show the relations and form of the alveolar bulb in a Pig in which the first permanent molar has erupted.
P. *vertical plate of palatine bone.* Pt. *lateral pterygoid plate.* T. *tympanic bulla.*

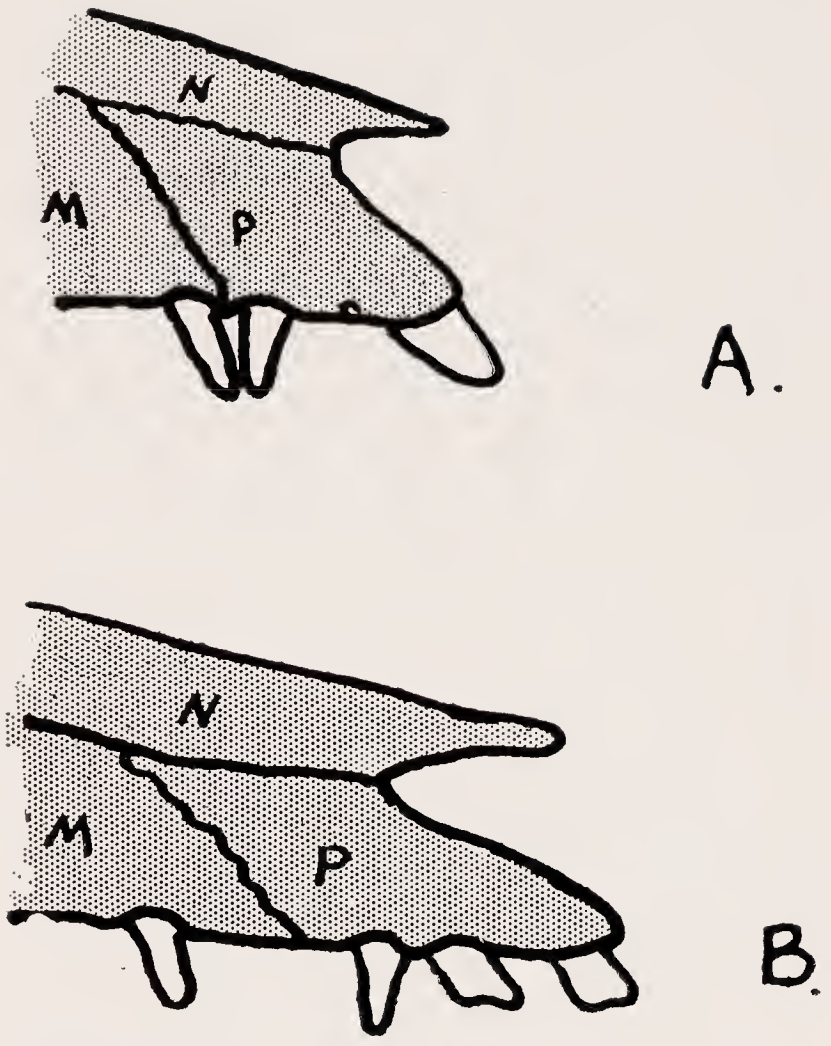

Figure 8. *Diagram to show the separation of the third deciduous incisor and the deciduous canine by growth at the premaxillary-maxillary suture in the Pig.*

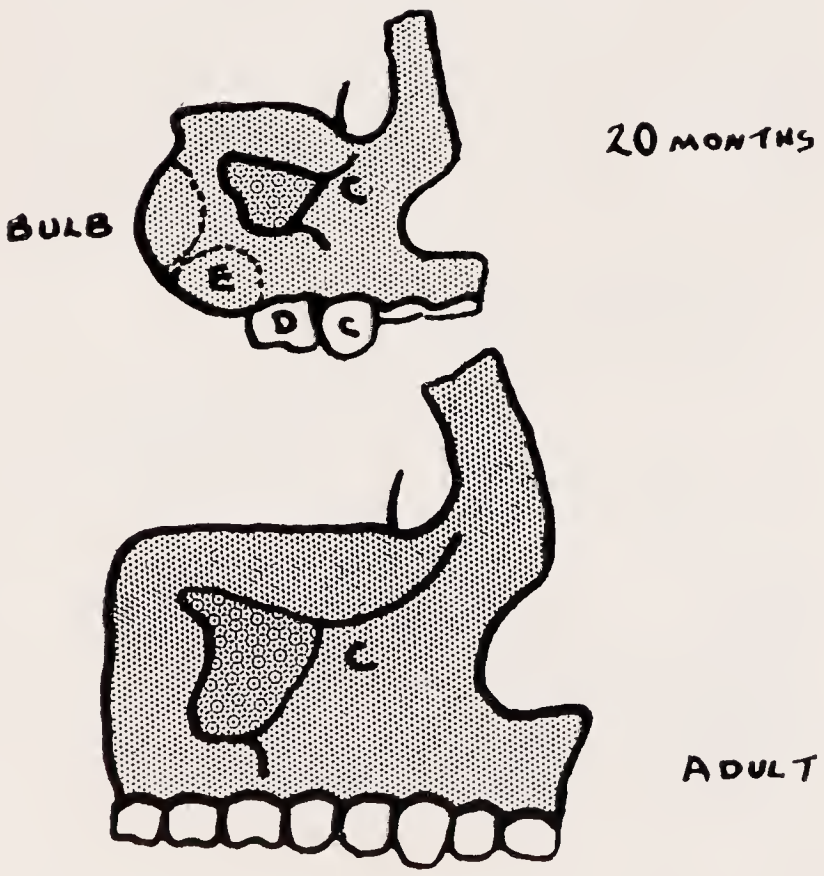

Figure 9. *Diagram to show the human maxilla at* 20 *months and in an adult. In the child the alveolar bulb which contains the calcified crown of the first permanent molar is shown at the back of the maxilla.*

related to the walls of the orbital cavity. It should be noted that two of the bones mentioned, the ethmoid and the sphenoid, are involved in both the cranial base and in the facial skeleton which suggests that growth at the middle and posterior facial suture systems is of importance only when cranial growth are more or less synchronous, that is, before and up to the end of the second year of life.

We are now in a position to commence an analysis of the growth changes involved in the development of the face. We first study the pig because it illustrates certain facts more clearly than the human and because it has been used in such important work as that of Humphrey and Brash in elucidating problems of facial growth.

Analysis of Facial Growth in the Pig.

1. The fronto-parietal and fronto-nasal sutures.

Between birth and the full eruption of the third molars the frontal bone in the pig increases in length by some 12 cms. This increase can take place at both the fronto-parietal and at the fronto-nasal sutures. Increase at the former would involve increase in the length of the cranial cavity. Within this period the length of the cranial cavity increases by not more than 3 cms. During this time the fronto-nasal suture (nasion) moves forwards from a position 1 cm. in front of the anterior end of the cranial cavity to a position $5\frac{1}{2}$ cms. in front. Meanwhile, before adulthood is reached, the fronto-parietal suture has closed although the fronto-nasal suture remains open even in old animals. From this we may conclude that the greatest amount of growth in length of the frontal bone takes place in front at the fronto-nasal suture and that this suture and the nasion move forwards relative to the front end of the cranial cavity during growth of the face.

At birth the posterior edge of the infra-orbital foramen is on the same transverse (coronal) plane as the fronto-nasal suture (nasion) ; in the adult animal it lies some 3 cms. in front of the nasion. That is, relative to the fronto-nasal suture, which is itself moving forwards relative to the front of the cranial cavity, the infraorbital foramen is moving forwards at a more rapid rate.

At birth the anterior cusps of the third deciduous molar lie below the infra-orbital foramen while in the adult animal the posterior cusps of the fourth premolar lie beneath the foramen. That is, relative to the infraorbital foramen the cheek teeth are moving through the alveolar bone. It might be thought the position of the teeth relative to the key ridge (the zygomatic process of the maxilla) could be taken as more direct evidence of forward migration, for one after another the permanent molar teeth lie beneath this landmark as they erupt, but it has been argued that the position of the key ridge migrates backwards by surface absorption of bone in front and deposition behind. Although I consider this unlikely I have used the position of the teeth relative to the foramen and the nasion in preference as the same conclusion is reached without any ambiguity.

2. The Alveolar Bulb

In the upper jaw of the pig the alveolar bulb is seen as a tubular structure projecting from the back of the alveolar process of the maxilla. It lies along the side wall of the skull below the orbit and extends backwards, when fully developed, to terminate just in front of the lateral pterygoid plate. It lies to the outer side of, but quite free from, the ascending process of the palatine bone.

In a new born pig the length of the bulb is about 1½ cms. At its period of maximum development, when it contains the calcified crowns of the second and third permanent molar teeth, it is about 3½cms. long. In the adult animal, after the third molar has come into place at the back of the alveolar process beneath the key ridge, the bulb has become reduced by a process of atrophy to form a flattened and somewhat fenestrated plate. As the bulb atropies from behind forwards the ascending ramus (vertical plate) of the palatine bone, which is covered on the outerside by the fully developed bulb, becomes exposed on the side wall of the skull. There can be no doubt that the permanent molar teeth develop within the bulb and one by one move forwards out of it ; and

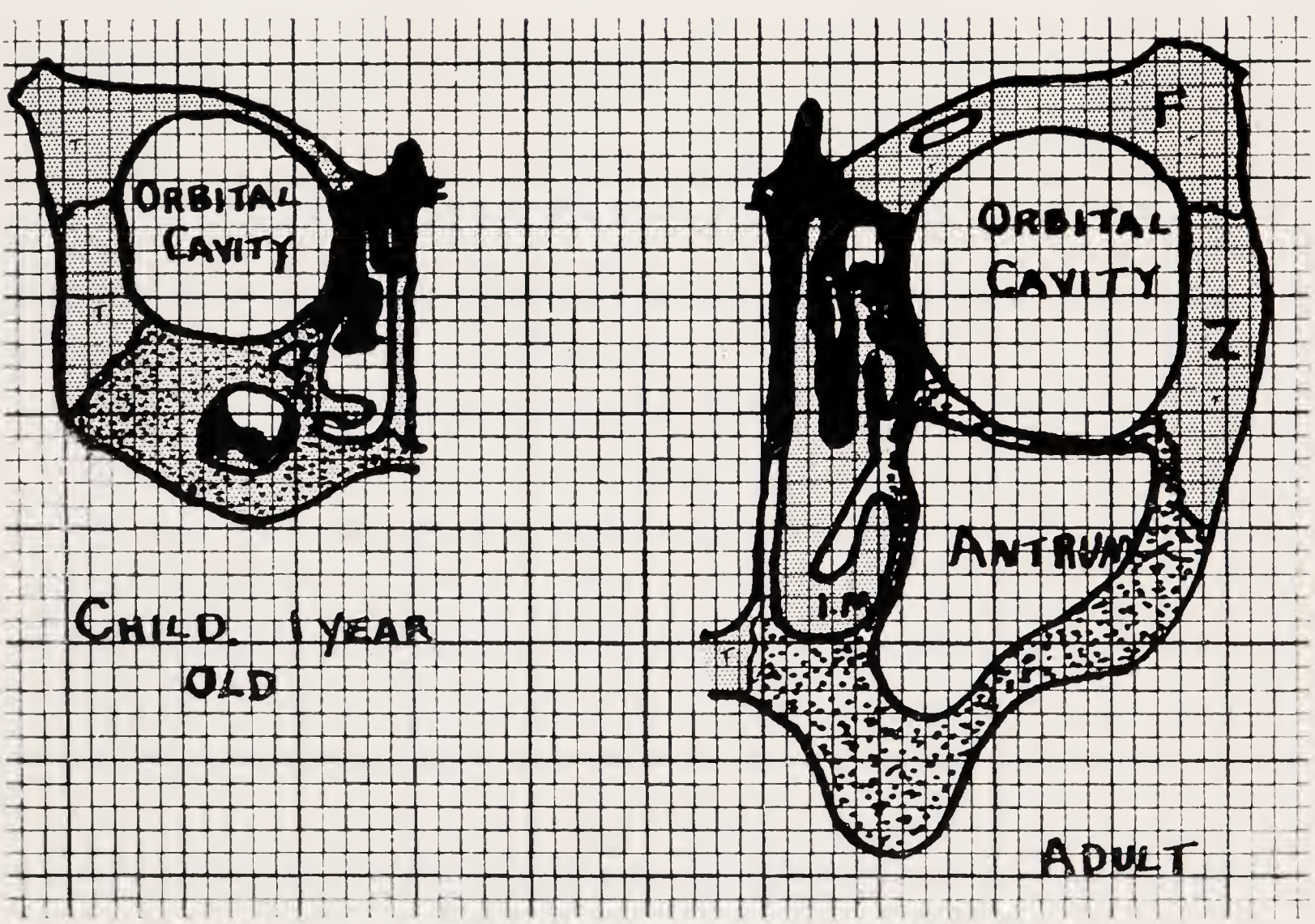

Figure 10. *Coronal section through the head of a child one year old and that of an adult. Maxilla is shown heavily stippled, the ethmoid in solid black* F. *frontal bone.* Z. *zygomatic bone.* I.M. *inferior meatus.*

that finally the bulb atropies as the third permanent molar moves on to the alveolar process. If there were no forward movement of all the cheek teeth through the alveolar bone in order to make room for the permanent molars at the back of the alveolar process the bulb with its contained teeth would have to become incorporated into a backward extention of the alveolar portion of the maxilla. This, I am quite sure, does not take place.

3. The Premaxillary-Maxillary Suture

I believe therefore, that we have adequate evidence that the cheek teeth of the pig move forwards through the alveolar bone. As the distance between the anterior member of the cheek tooth series and the canine does not grow any less, but rather increases, with age, it is evident that a great amount of growth in the length of the alveolar border of the upper jaw must take place, not at the back of the maxilla, but at the premaxillary suture. Growth at this suture, furthermore, makes room, not only for the forward migrating premolar and molar teeth, but for the replacement of the deciduous canine by the very much larger permanent canine. In the skull of a young animal the deciduous third incisor, implanted at the back of the premaxilla, and the deciduous canine, implanted at the front of the maxilla, are very close together on either side of the premaxillary suture, there being no more than 1 mm. between them at the alveolar border.

Before the deciduous teeth are shed the distance between them at the alveolar border has increased to 16 mms. and the deciduous canine lies some 9 mms. behind the suture. When the permanent canine erupts its mesial (anterior) surface comes to within 1 to 2 mms. of the suture at the alveolar border. It is obvious from these changes that there is a great amount of growth taking place at the suture resulting in an extention of the alveolar border of the maxilla and premaxilla.

The conclusion we can reach at this stage of this investigation of facial growth in the pig is that the teeth move forwards through the alveolar bone ; that the alveolar bulb is a special process of the maxilla in which the permanent molar teeth can develop until room is made for them at the back of the alveolar process by the forward movement of the deciduous molars and their successors ; and that the greatest amount of growth in the length of the alveolar process of the maxilla takes place in front at the premaxillary suture.

That some growth takes place at the back of the maxilla at the middle and posterior suture systems is indicated from the growth in length of the alveolar bulb and from what we have already stated regarding the structure of the cranial base in the pig. The difference in length of the bulb in the new born animal and at the period of its maximum development is between 2 and $2\frac{1}{2}$ cms. We must allow also for the fact that the downward growth of the maxilla (increase in vertical height) carrying the bulb with it, brings the back surface of the bulb into relation with the more forward placed lower portion of the sloping pterygoid plate. We can allow altogether for some 4 cms. increase at the middle and posterior facial suture systems but not any more than this amount for otherwise the back of the alveolar bulb would be carried away from the pterygoid plate.

From a study of the relations of the cranial base to the facial skeleton in the pig it would appear that most of this growth takes place at the suture between the palatine bone and the pterygoid plates (the posterior facial suture system), as this is associated with growth at the synchondrosis between the postsphenoid and presphenoid elements of the cranial base (*Figure* 3). The extent to which the length of the cranial base increases from birth up to the time of maximum development of the alveolar bulb is about 3 cms. but all this growth does not take place at the presphenoid-postsphenoid synchondrosis as the synchondrosis between postsphenoid and basi-occipital is also involved.

Between birth and adulthood the alveolar border of the maxilla (excluding the bulb) increases by about 12 cms. of this about half is necessary to carry the permanent molars the combined lengths of

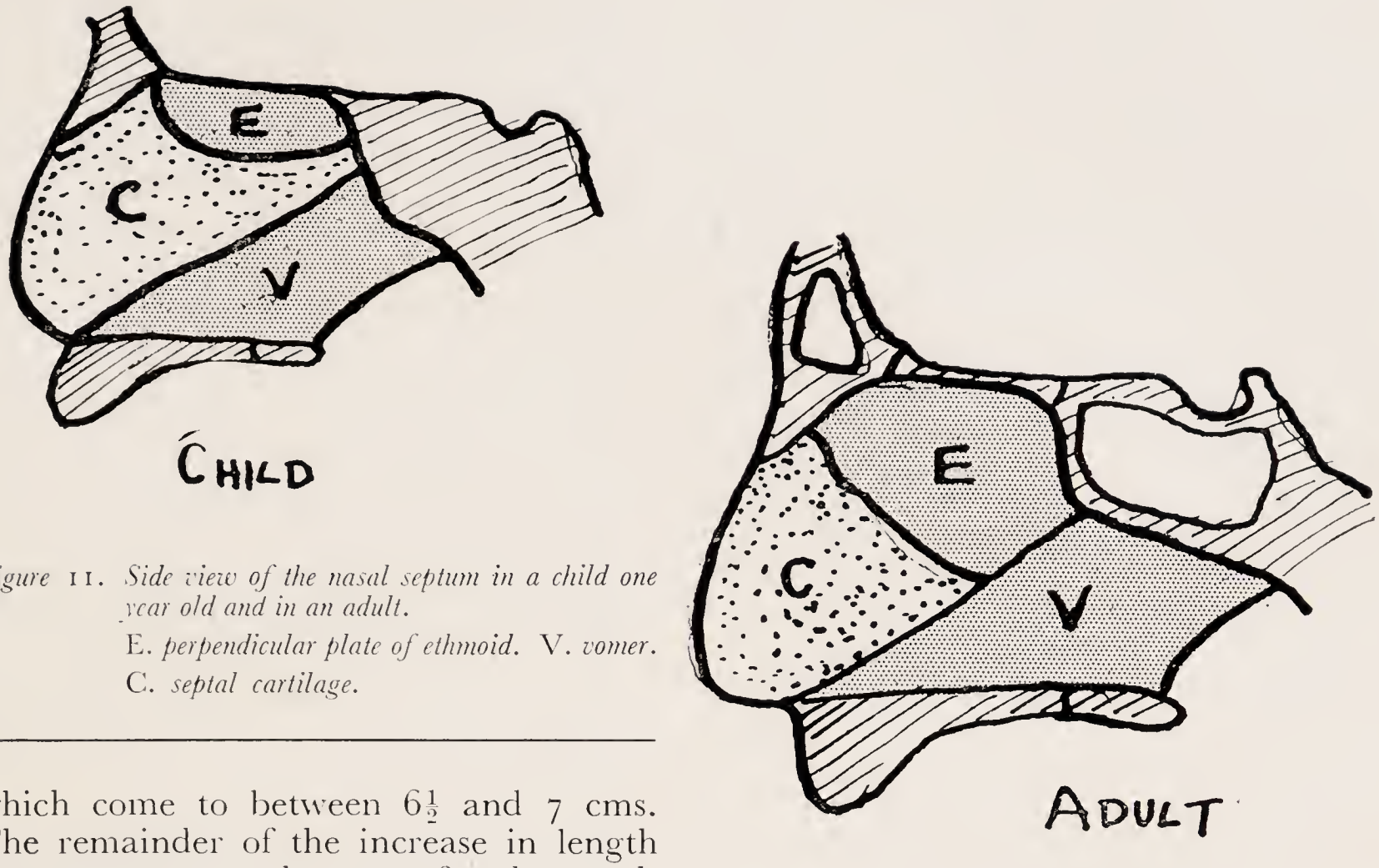

Figure 11. *Side view of the nasal septum in a child one year old and in an adult.*
E. *perpendicular plate of ethmoid.* V. *vomer.*
C. *septal cartilage.*

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which come to between $6\frac{1}{2}$ and 7 cms. The remainder of the increase in length is necessary to make room for the much larger permanent canine and the increased space between the first cheek tooth and the canine. Most of this growth therefore takes place at the premaxillary suture.

Growth of the Human Face

1. Facial Suture Systems

The human face differs from that of the pig in that forward growth, which is so predominant a feature in the latter is much reduced and growth in both height and width are relatively of much greater importance. Of the three facial suture systems, that between the maxilla and premaxilla is closed in foetal life, and the two suture systems behind the maxilla, instead of running upwards and forwards as in the pig, form two limbs at right angles to one another (*Figure* 4). Growth at these sutures would thrust the maxilla downwards and forwards, but it is clear that any growth involving the horizontal or orbital sections of the suture systems would result, as Brodie points out, in an excessive increase in the height of the orbital cavity, or, if all the growth were limited to the maxilla, in an increase in the height of the maxillary antrum above the level of its ostium. Growth of the human orbital cavity is directly related to growth of the eyeball and by the end of the second year the eyeball has reached between 75 and 80% of its adult dimensions. Furthermore, the position of the ostium ad antrum is always close to the roof of the antrum and it marks the position of the original outpouching of the antrum from the nasal cavity which commences in foetal life. All the evidence relating to the vertical growth of the antrum after the second year indicates that this is downwards in direction as the alveolar process and the under surface of the hard palate descend by surface deposition of bone on the oral surfaces and absorption on the floors of the nasal cavities and the antra. Hence we can tentatively conclude at this stage of our investigation that very little growth takes place at the horizontal (orbital) segments of the facial suture systems after the second year. If we can thus eliminate the possibility of any great amount of growth at the orbital segments we can also eliminate the possibility of any extensive growth at the vertical (spheno-maxillary) segments. This conclusion is contrary to the statement made by Keith that " New bone is being constantly formed in the maxillary floor of the orbit, in the roof of the maxillary sinus, leading to a thrusting downwards of the body of the maxilla and

palate." Therefore we must investigate the matter in more detail.

2. The Development of the Maxillary Antrum

Symington[9] in his 'Atlas of Skiagrams' shows a series of dissection of the antrum as seen from the outer side. The drawings are of natural size and it is interesting to notice that the distance between the ostium and posterior wall of the maxilla is the same in the female infant of two years as in the girl of sixteen years of age. The total length of the antrum is 2.5 cms. in the former and 3.5 cms. in the latter and it follows that the increase in length of the antrum between these ages has taken place, not behind the ostium, but in front of it. That is, after the end of the second year the greatest extension of the antrum in the antero-posterior dimension is not backwards as postulated by Keith, but forwards. At two years of age the antrum lies on the inner side of the deciduous molars and the crypt of the first permanent molar as it has not yet extended outwards over the teeth. In the girl of sixteen the floor of the antrum is related to both the premolars and to all the permanent molars, although the 3rd molar has not yet erupted. In both the child and the adolescent the front of the floor of the antrum is related to the first deciduous molar or to its successor the first premolar. As the antrum in its growth extends forwards relative to the ostium the teeth must move forwards in the alveolar bone to maintain this relationship.

3. Relation of the Teeth to the Infra-orbital Foramen

At eighteen months the infraorbital foramen lies above the contact point between the deciduous canine and the first deciduous molar. In the adult the foramen lies above the second premolar or the contact point between the first and second molars. As in the pig the foramen itself cannot be taken as a fixed point but there is no evidence whatever to suggest that in the human it is moving backwards with facial growth. If it is moving forwards or even remaining stationary in position the relationship of the teeth to it indicate that the teeth are moving forwards through the alveolar bone.

4. The Human Alveolar Bulb

An alveolar bulb is present at the back of the human maxilla but it differs from that of the pig in all that the permanent molar teeth do not develop within it at the same time but do so one after another with long intervals between so that at any time the human bulb never contains more than one calcified tooth crown. As a result the back of the bulb expands and is reduced at intervals as each of the permanent molars develop within it and in turn move forwards out of the bulb on to the alveolar process of the maxilla. In the pig the first, second and third permanent molars erupt in the sixth, the twelfth, and the twentieth month, in man the corresponding teeth erupt during the sixth, twelfth and eighteenth year.

This periodic development of the bulb in man is quite independent of any general growth at the back of the maxilla and does not involve any of the sutures. It cannot be said that the erupting permanent teeth are thrust forwards from any fixed basis; they are in fact drawn forwards by a dense cord of fibrous tissue which lies in a groove along the lower surface of the bulb and which is continuous in front with the oral mucous membrane. To this cord, which I have called the 'molar gubernacular cord,' the follicles of the developing permanent molar teeth are attached.

5. The Space required for the Permanent Molar Teeth

We know the amount of space which must be made available behind the second deciduous molar or its permenant successor the second premolar for the permanent molar teeth. It is, in the upper jaw, a little less than the combined mesio-distal lengths of the three permanent molars, that is, on the average, between 30 and 31 mms. The space required is a little less than this because the first molars move forwards slightly into the space occupied by the second deciduous molars when these teeth are shed as the premolar is a smaller tooth than the deciduous molar which preceeds it. The current teaching which postulates that space is made for

the permanent teeth by a backward extention of the maxillary alveolar process requires that something less than 10 mms. of bone are deposited at the back of the maxilla between the second year and the sixth, another 10 mms. between the sixth. year and the twelfth and another 9-10 mms. between the twelfth and eighteenth year. This would involve a steady and continuous thrusting forwards of the whole maxilla between the second and eighteenth years relative to the anterior cranial segment, or else, as Keith postulates, a marked degree of growth at the spheno-ethmoidal suture of the cranial base so as to carry the anterior cranial segment and the maxilla forwards from this suture and from the pterygoid plates of the sphenoid bone. The objections to this hypothesis are :—

1. Growth of the anterior segment of the cranial base is not continuous in amount and rate from the second to the eighteenth year. It is greatly reduced after the second year and very slightly in amount after the seventh year by which time the cribiform plate of the ethmoid and the body of the sphenoid have reached adult dimensions.(10)

2. Most of the growth that does take place at the cranial base from birth onwards takes place not at the spheno-ethmoidal suture but at the synchondrosis between the basi-occipital and basi-sphenoid but growth here does not involve a forward movement of the maxilla relative to the pterygoid plates. Between birth and adulthood the distance between the anterior lip of the pituitary fossa and the foramen caecum, that is across both the spheno-ethmoidal and fronto-ethmoidal sutures, increases not by 30 mms. but by 10-12 mms. In the same period the distance between the anterior lip of the pituitary fossa and the basion (anterior border of the foramen magnum), that is across the spheno-occipital synchondrosis, increases by about 25 mms.

6. Growth changes in the Human Maxilla

The maxilla is related to three distinct regions of the face, the orbital, the nasal and the oral and as we should expect each of these regions has a distinct pattern of growth. In a new born child the length of the orbital surface of the maxilla is about 70% of the length of the alveolar border. In the adult it is about 50% of the alveolar length. That is the developing prognathism is due, at least in part, to a relative change in the proportions of the maxilla itself. It is due to surface deposition of new bone around the outer and anterior surfaces of the alveolar portion of the upper jaw and this in turn postulates a forward movement of the teeth. In the Chimpanzee this developing prognathism is even more evident. In a young animal, in which the deciduous dentition was complete and the premaxillary suture closed on the facial surface the orbital length of the maxilla was 55% of the alveolar length. In a young adult, in which the third permanent molars were erupting it was 40%. No thrusting forwards of the maxilla from behind and above could bring about such a change in proportion between the orbital and alveolar parts of the bone unless we postulate absorption of the bone at the front of the face above the level of the alveolar process The evidence on the contrary indicates that there is bone deposition at the front of the upper portion of the face as well as in the alveolar region. At three years of age the human nasion is some 5 mms. in front of the foramen caecum which marks the front end of the cranial base. In the adult as the result of surface deposition and the development of the frontal sinus the distance between the nasion and the foramen caecum is on the average some 15 mms. but may reach 25 mms. or more. This fact makes unreliable any measurement of facial prognathism which involves the nasion as this point does not bear any constant relationship to the front of the cranial base but is itself a part of the facial skeleton. Keith brought out the importance of this upper facial region and pointed out that it has nothing to do with growth of the brain but is directly related to the development of the masticatory

apparatus. He also stated that here at any rate growth is due, not to suture growth, but to bone deposition at the surface.

Keith, as we have seen, postulated a continual growth at the back of the maxilla up until the time of the eruption of the third permanent molars and this involves growth at the pterygo-palatine sutures and the spheno-ethmoidal suture of the cranial base over the same period of time. During late foetal life and for the first two years after birth, when the brain is growing rapidly, there is growth at these sutures and the maxilla does grow backwards to maintain its relationship with the sphenoid and its pterygoid plates and in so doing the back of the maxilla comes to overlap part of the outer surface of the ascending ramus (vertical plate) of the palatine bone. After the second year however growth of the brain is much less rapid and by the seventh year growth at the sutures behind the maxilla and between the sphenoid and ethmoid has practically ceased.

7. Vertical Growth of the Human Face

When a coronal section through the face of an adult is compared with that of a child one year of age the following facts are significant :—

1. The height of the orbital cavity in the child is about 70% of the adult height.
2. The nasal cavity consists of two portions, an upper ethmoidal, related to the orbital cavities between which it lies, and a lower maxillary part. Between one year of age and adulthood the ethmoidal portion increases by 25% while in the same period the maxillary portion increases by 100% in its vertical dimension.
3. The maxillary antrum is 3 mms. high in the child and 30 mms. high in the adult. In both the child and in the adult the opening between the antrum and the nasal cavity is above the attachment of the inferior turbinate bone and at the level of the roof of the antrum.
4. There is between childhood and adulthood a great increase in the height of the inferior meatus of the nasal cavity ; the meatus is 3 mms. high in the child and 15 mms. high in the adult.

If, as it has been stated, growth of the maxilla in vertical height is by a thrusting downwards of the bone at the fronto-maxillary, ethmo-maxillary and zygo-matico-maxillary sutures the following changes must be postulated to bring about the adult proportions :—

1. Deposition of bone on the orbital surfaces of the maxilla so as to maintain the normal height of the orbital cavity which reaches 75-80% of its adult dimension by the end of the second year.
2. An extension upwards of the maxillary antrum above the former level of the ostium and, as the ostium always remains at roof level an upward migration of the position of the ostium itself.
3. An upward migration of the attachment of the inferior turbinate bone to the maxilla and palatine bones so as to bring about the increase in height of the inferior meatus.

It is however much more likely that the changes in size and proportion between the child and the adult take place in the much more simple manner postulated by Brash[11] ; that is by a deposition of bone on the under surface of the hard palate and along the alveolar margin, associated with an absorption of bone on the floors of the nasal cavities and the antra. Brash wrote in his Dental Board lecture " Increase in height of the body of the maxilla and of the antrum can take place only by downward growth of the alveolar margin. The only other possibility is by addition to the floor of the orbit with excavation beneath, but this would imply the taking up of the infraorbital nerve into the cavity of the antrum and an incredible suture growth of the frontal process of the maxilla and malar (zygomatic) to maintain and increase the depth of the orbit itself. . . . The floor of the orbit, so far as growth of the body of

the maxilla is concerned, has, for these reasons, to be taken as relatively fixed, and the increase in height of the antrum must be almost entirely at the expense of the growing alveolar bone."

8. The Nasal Septum

This is made up of two bones, the perpendicular plate of the ethmoid and the vomer and of a plate of cartilage between them. In a child one year old the cartilage passes back to make contact with the body of the sphenoid and so completely separates the vomer and ethmoid. At six years of age the cartilage, as a rule, no longer passes back far enough to make contact with the body of the sphenoid but it still shows a long wedge passing backwards between the ethmoid and vomer. The growth of this cartilage as a wedge between the bones of the septum will keep the vomer in contact with the hard palate as this descends. Very often the rate of growth of the cartilage is greater than the rate of descent of the hard palate and the nasal septum becomes buckled and deflected to one side or the other.

Summary of Facial Growth in Man

During late foetal life and for about the first two years after birth brain and eyeball grow rapidly separating the bones which form their capsules along the suture lines. At these sutures the bones grow towards one another in order to maintain contact but there is no thrusting apart of the bones at the suture lines as a result of bone growth itself. During this time the maxilla is thrust downwards by the growing eyeball and growth takes place at the fronto-maxillary and ethmo-maxillary sutures along the inner side of the orbital cavity and at the outer side of the cavity. Growth at the coronal suture during this period takes place at both its anterior (presphenoid) and posterior (postsphenoid) limbs. Growth at the anterior limb will thrust the ethmoid, maxilla and palatine bones forward from the sphenoid and its pterygoid processes while growth at the posterior limb will carry the whole face forwards with the anterior cranial segment. Growth at the spheno-ethmoidal suture, which is the basal element of the anterior limb of the coronal system, is related to growth of the brain. Growth at the spheno-occipital synchondrosis is largely independent of growth of the brain. After the end of the second year brain and eyeball have reached 70-80% of their adult dimensions and growth at the sutures from this time onwards becomes progressively reduced. Growth in the vertical height of the maxilla is no longer due in any significant extent to a thrusting downwards of the bone from the cranial base as a result of growth of the eyeball but to a deposition of bone on its palatal and alveolar surfaces associated with an internal excavation of the nasal cavities and the maxillary air sinuses. At the coronal suture growth becomes limited to its posterior limb which passes behind the sphenoid below the level of the pterion and at the cranial base the spheno-occipital synchrondrosis becomes the predominant growing region. Hence, after the second year there can be very little growth at the back of the maxilla and further growth of this bone in the antero-posterior direction is due to deposition of bone on its facial and anterior surfaces. This in turn is associated with an anterior and outward migration of the teeth through the developing alveolar process so as to make room at the back for the erupting permanent molar teeth.

In the development of the facial skeleton three types of growth play a part :—

1. Sutural growth which is associated with the growth of such an organ as the brain growing within a protective capsule ; this type of growth is most extensive during late foetal life and for the first two years after birth.
2. Growth by surface deposition and absorption of bone. This becomes of more and more importance from the first year onwards. After the seventh year this type of growth is predominant in the development of the face.
3. Cartilagenous growth ; this is of most significance in early foetal life when the skull base, the nasal capsule and the branchial arches are all formed in cartilage. After the seventh year the most important cartilagenous regions of the skull

are the spheno-occipital synchondrosis, the cartilage of the mandibular condyle and the cartilage of the nasal septum and they all play an important part in facial growth throughout adolescence. The former by thrusting the anterior and posterior cranial segments apart is of importance in the growth of the pharynx and in the space required for the growing muscles of mastication (Keith) ; the mandibular cartilage is of vital importance in thrusting the mandible downwards and forwards from the middle cranial segment. As the mandible carries the tongue with it, this cartilage plays an important part in the descent of the hard palate and the whole of the upper face. In foetal development the descent of the tongue is the factor which allows the palatal folds to meet one another over the dorsum of the tongue and by their fusion bring the palate into being. The nasal cartilage has not been given any important place in the mechanism of facial growth but it is possibly associated with the growth at the sutures between the maxilla and premaxilla and the maxilla and nasal bones which is of importance in the growth of the face in such animal as the pig.

Growth of cartilage is interstitial in nature and the epiphyseal type of growth which takes place by the conversion of cartilage into bone is, unlike sutural growth, independent of such an organ as the brain ; hence the development of the cranial base at the spheno-occipital synchondrosis is quite different in nature from the growth of the bones of the cranial vault so that in the skull of a microcephalic idiot as in hydrocephalus, the cranial base may show but slight deviation from the normal dimensions.

The great differences in the mechanisms of facial growth in early childhood as compared with late childhood should make us cautious of applying findings which are valid for one period to the other and should also warn us of the dangers involved in the uncritical use of the superimposition of X-rays or skull outlines along various planes or any of the so-called ' fixed points.'

Although in this paper I have primarily concerned myself with a consideration of growth as it affects the upper jaw I would like to conclude with a brief summary of what is known of growth of the lower jaw. When we turn to the mandible we find that the mechanism of growth is quite different from that of the upper jaw in certain respects. The chief factor in antero-posterior growth of the mandible is the growth and conversion into bone of the hyaline cartilage which is situated in the head of the condyle. As a result the mandible is thrust downwards and forwards from the middle cranial segment which carries the temporo-mandibular joint. There is, in the mandible, as in the maxilla, an alveolar bulb, which is however buried in the ascending ramus of the bone. In a young pig its rounded posterior surface can be seen projecting above the opening of the inferior dental foramen. In an adult pig the bulb can be opened into from the inner side of the ramus and is found to be an empty cavity which has been vacated by the third molar after that tooth has moved forwards into position at the back of the alveolar process. While, therefore, it is evident from the history of the bulb that the lower teeth move forwards through the alveolar bone it would appear that they do not do so to the same extent as in the upper jaw. Occlusion between the teeth of the upper and lower jaws would appear to depend in part on the teeth keeping pace with one another as they move through the alveolar bone but also on a forward movement of the whole mandible from behind relative to the upper jaw. In the case of the upper jaw most of the growth takes place in front either in the premaxillary suture as in the pig or as the result of surface deposition as in the Chimpanzee after the closure of the premaxillary suture. In the lower jaw, although there is surface deposition at the front of the bone so that in the pig the alveolar process is carried

more and more in front of the basal portion of the bone, most of the growth in the length of the mandible appears to take place behind at the condyle and the posterior border of the ramus. But this is not suture growth and is much more like the growth which takes place at the epiphyseal cartilage of a long bone or at the spheno-occipital synchondrosis.

If this analysis of facial growth is correct in outline then we have not only a difference in the mechanism of growth of the upper and lower jaw but in the upper portion of the face the type of growth which is predominant in early childhood is quite different in character from that which is predominant in later childhood and during adolescence.

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DISCUSSION

The President said that the members were deeply indebted to Dr. Scott for a remarkably interesting piece of work. The subject was one of the greatest complexity and to many of them it was extremely difficult.

He had been very pleased to hear some of the conclusions at which Dr. Scott had arrived as the result of his work, because he felt that they were right, though perhaps on no very good evidence. He himself had looked at the matter from the histological standpoint and he agreed that the teeth were moving forward and downwards through the bone. He did not think that necessarily made the maxilla any larger, because the teeth were simply moving in it, but that they were moving one could have no doubt whatever from the histological standpoint.

Again, he thought all the members would agree with Dr. Scott on the question of surface deposition, but he did not think all of them would agree on the relative importance to be attached to suture growth and surface deposition, in quantity and in time. Dr. Scott had given very good reasons for thinking that these two types of growth (he was not referring to cartilage at the moment) prevailed at different age periods, and he thought that when the members had considered Dr. Scott's work more carefully they would very likely think that he was right, but Dr. Scott would forgive them if, on hearing the proposition for the first time, some of them felt a little doubtful about it at the moment. There were certain difficulties that occurred to him ; for instance, in the matter of suture growth. He had been a little shocked to hear Dr. Scott say that no active growth took place at sutures, because, from the histological standpoint, there was a tremendous amount of growth at sutures at certain ages. If one wanted to find out what was going on at a particular place at a particular time, one could cut a piece out of the skull of a kitten, for instance, and see.

It seemed to him that perhaps the anatomist took another view as his main standpoint ; he looked at a bone and measured it, and then he saw it again at a later age and measured it again. From the anatomical standpoint a bone might be the same bone at two ages, but from the histological standpoint it might not be the same bone at all, because it was being absorbed in one place and more was being laid down in another, so that none of the original bone was left.

Why was it that in a condition like oxycephaly, which was characterised by early obliteration of so many sutures, there was always such a minute maxilla ? Was that due to the suture growth failing during the first two years ? Was the failure of the growth of the maxilla due entirely to that or was there also some interference with its growth after the first two years ? There was nothing in oxycephaly, so far as was known, to interfere with the surface deposition of bone.

Mr. H. T. A. McKeag said that he had the advantage from his point of view, but the disadvantage from the point of view of contributing to the discussion, of having gone into the subject of the paper with Dr. Scott previously. They both served in Queen's University, Belfast, and for a considerable time he had been aware of Dr. Scott's ideas about the development of the face.

He was sorry that on the present occasion Dr. Scott had not dealt with the mechanism by which the teeth were moved forward through the bone. The assumption used to be that the whole thing was thrust forward from behind. If that theory was abandoned, it was necessary to suggest some other mechanism by which the teeth were moved, if deposition in front was the mode of growth. He knew that Dr. Scott's answer was that the mechanism was a fibrous linkage of the teeth which drew them forward, and he himself accepted that as an explanation of the normal mode of growth, but it happened that for a considerable time he had been looking at the phenomena which occurred in the mouth in the light of the hypothesis that depositional growth was responsible for the major part of the growth of the face in the later stages. It seemed when Brash put forward his theory that it did offer a prospect of explaining the things which were seen going on in the mouth (he had not realised the full implications of it and probably did not do so now), so that, somewhat in advance of Dr. Scott communicating his ideas to him, he had been looking at things from that point of view, and he thought the hypothesis explained all the phenomena to which he had applied it on the practical side.

A stumbling-block which he had had for a considerable time was that the theory of the drawing forward of the teeth through the fibrous linkage did not seem to cover the case where a break was made in the arch through the extraction of a tooth during the development period. Assuming that the teeth had been drawn forward through deposition at the front, one would expect to find the segment anterior to the break continuing to go forward and the segment behind the break lagging behind and not going forward, whereas in fact the anterior segment or the teeth in the anterior segment tended to lag behind and the teeth in the posterior segment tended to go forward. It seemed to him that, in order to account fully for the phenomena seen in the mouth in that connection, it was necessary to postulate an additional factor, namely, the thrust of the eruption of teeth pushing forward and so contributing to the forward movement of the whole arch. One rather difficult point in that connection was that, whereas, in the comparatively small proportion of children that he saw who had really adequate movement forward of teeth, the hypothesis of the drawing forward of the teeth through the fibrous linkage would suffice to account for the phenomena, in the great majority of children it did not. In order to get the teeth coming forward enough to give a normal occlusion, there would have to be in addition the thrust of erupting molars from behind.

There was one point which he thought was worth mentioning, namely, that the synchondrosis of the spheno-occipital junction must be of very great importance in relation to malocclusion. He was not sure whether Dr. Scott had developed his idea about the proportion of growth which took place there, but that, it seemed to him, must be the point at which the relationship of the upper and lower jaws was eventually determined. The mandible, of course, was attached to the posterior segment of the base of the skull, and the carrying of that back relative to the anterior part of the base of the skull seemed to him to depend on the spheno-occipital synchondrosis ; that was really the point at which the original relation-

ship was most likely to be determined, whether it turned out normally or not.

Mr. J. Allan said that he would like to pursue the subject of suture growth on one small point that had occurred to him. Dr. Scott postulated that suture growth was passive, but it needed some active influence to bring it about. It had occurred to him that some active influence was needed to bring about some growth of the premaxillary suture. Did Dr. Scott expect to get that influence from the tongue ? If so, it seemed to him that the posture of the lower jaw which brought the tongue into relation with the maxilla might have a very important bearing on the amount of growth that took place at that suture.

He wished to congratulate Dr. Scott on his very interesting paper.

Mr. L. Russell Marsh asked whether Dr. Scott thought that the musculature of the face played a part in facial growth.

Miss R. Casely said she would like to thank Dr. Scott for his very interesting paper, which had given the members much food for thought and had made them realise how many factors were controlling growth at different times. She thought that could be connected to a considerable extent, with the findings of Helman, who gave measurements of skulls. He picked out skulls at certain ages ; he could naturally determine the ages according to the tooth eruption, and he compared the growth in depth of the face, with the posture of the face. Dr. Scott showed how the growth went on at the cartilage of the mandibular condyle ; the suture growth in the maxilla stopped and there was just the deposition of bone in the maxilla, but the mandible was still carried forward and the lengthening of the mandible continued.

Dr. James Scott, in replying to the discussion, referred to the President's remarks and explained that when he had said that no active growth took place at sutures he had not meant that no histological growth took place there ; he had meant that growth of bones at sutures was not a factor that thrust the bones apart. There was histological activity going on.

(*Drawing on blackboard and explanation*).

The sutures remained long after the growth had ceased. They could be seen on the face and on the skull long after the age of 20 or 25. They were regions in which adjustments could take place. For example, if the skull received a sudden shock they acted as shock-absorbers and they protected the brain. He did not think, however, that they were growing regions after about 20 to 25 years of age.

He thought that what happened in various pathological conditions such as oxycephaly and hydrocephaly was a matter which could be investigated and on which one could learn a great deal. He would like to apply his theory to pathological conditions, but he had not yet begun to do that. The two extreme conditions of brain size, microcephaly, in which the brain was very tiny, and hydrocephaly, in which the whole skull ballooned outwards, would seem to have different types of skull, but the cranial base was much the same in both ; the difference was due to growth of the brain. That did not affect the synchondrosis between occipital and sphenoid ; it affected only the sutures. The growth of the cranial base was brought about by the conversion of cartilage into bone, and whether the brain was tiny or ballooned out that growth would continue. That, he thought, was the reason why the same type of cranial base was found with apparently very different types of skull.

In regard to the mechanism which moved the teeth forwards in the jaw, he had dealt with that separately and he would perhaps have an article on the subject in the *British Dental Journal*.

(*Drawing on blackboard and explanation*).

The fibrous tissue grew backwards and lay in a groove in the bottom of the bulb. The teeth were not lying in the bulb themselves. They were connected to the mucous membrane of the mouth by the fibrous column. After the teeth had erupted they were still connected with one another, chiefly by the periodontal membrane. He did not look upon the dentition as separate units, but he regarded the whole upper and lower dentitions as two separate organs, just as the liver and the spleen were two separate

organs. If growth took place in the front of the face it would be the growth of the fibrous tissue, the general connective tissue, and that growth of the connective tissue in the front part of the face was related to the fibrous tissue connected with the teeth. The alveolar bulb was quite plastic and it had nothing to do with tooth eruption or movement. The teeth were pulled forward by the fibrous tissue. Part of the answer to the question " What makes the teeth move forwards ?" was that the teeth were all connected together and growth in the front of the mouth would pull all the back teeth forwards.

When a tooth was extracted scar tissue was formed and that scar tissue became dense fibrous tissue and contracted.

(*Drawing on blackboard and explanation*).

Some work had been done in America on extracting teeth, letting the socket heal up and then cutting sections, and it had been found that after some time transeptal fibres were formed, and as the scar tissue went on contracting it tended to keep the teeth together. That was a partial explanation of some of the things that happened when one extracted a tooth, broke the dental arch and distorted the dental organ.

In regard to muscles, he was sure there was an important relationship between muscle growth and facial growth. The muscles of mastication continued to develop until the third molars erupted, and then they were developed fully ; in other words, they continued to develop as the dental organ developed. The synchondrosis at the base of the skull, by separating the front end of the skull from the back end, increased the space in which the muscles of mastication developed, and it was an important factor in allowing space for the muscles of mastication which were attached to the maxilla and the mandible.

On the motion of the President, a vote of thanks was accorded to Mr. Russell Marsh and Dr. Scott.

The Secretary read a letter from the American Association of Orthodontists conveying the greetings of that Association to orthodontists in this country and inviting them to attend a meeting of the Association to be held in New York on May 2nd to May 6th, 1949. He asked that any member who proposed to attend that meeting would inform him of the fact.

The meeting then terminated.

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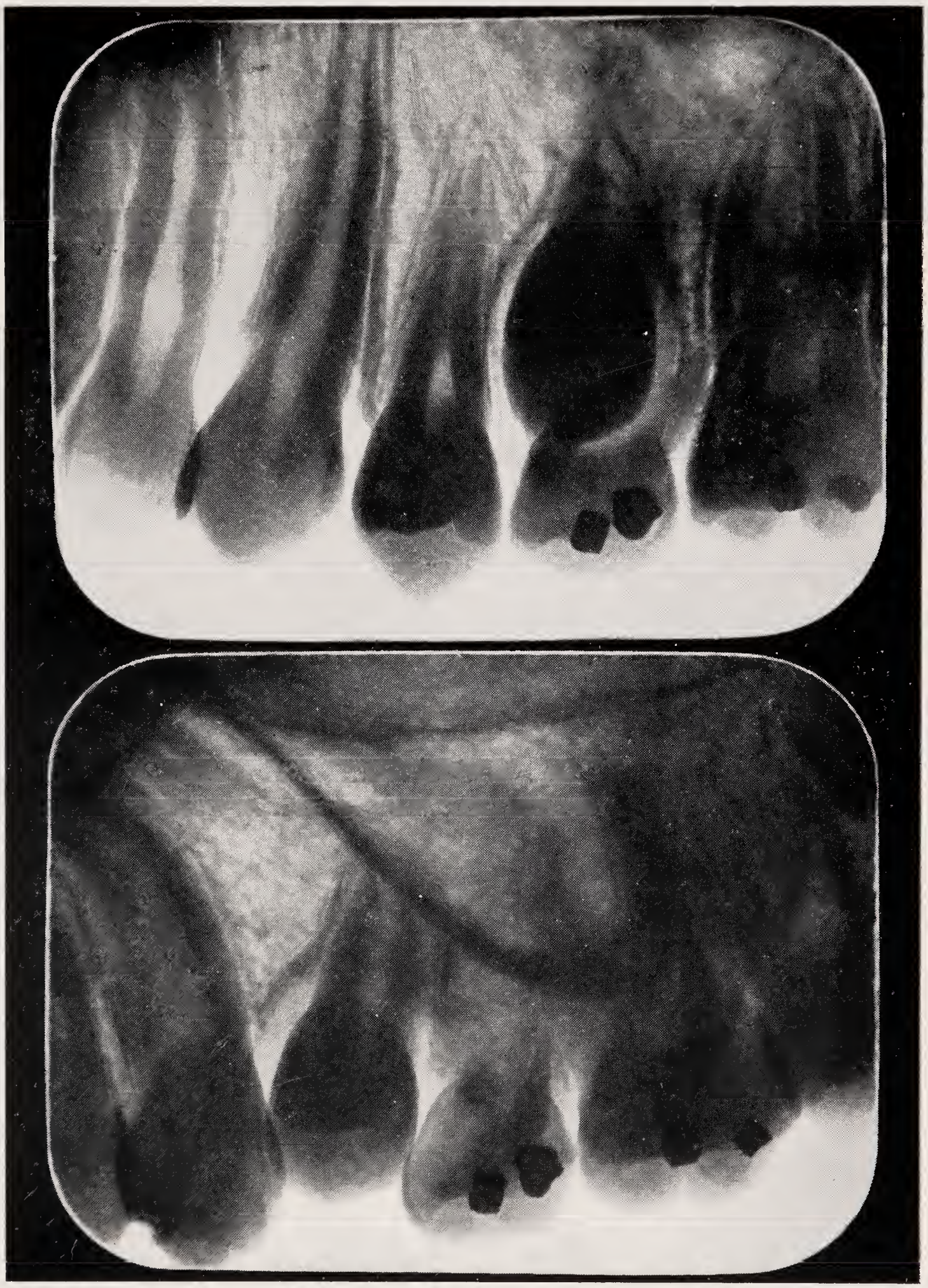
FORWARD MIGRATION OF AN UPPER SECOND PREMOLAR

By MURIEL P. MICHAELIS, L.D.S. (Eng.).



The slide shown is more or less self-explanatory and contains two films of the same boy. The first, taken in June 1947 at 11 years and 1 month, shows $\underline{5}|$ in position above $\underline{E}|$, perhaps slightly mesial to normal. The second, taken in

March 1948 at 11 years and 10 months, shows that after the extraction of $\frac{4}{}$ in July 1947, the $\frac{5}{}$ has moved forwards and is erupting into the position vacated by $\frac{4}{}$. The $\frac{E}{}$ is still quite firm.

In view of the recent work of Professor Friel and others on tooth movements this case seems to be of some interest.

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DISCUSSION

Mrs. Michaelis: I have only one slide and I think it is self-explanatory.

The slide shows two films of the same patient, a boy aged 11 years and 1 month in the first film and 11 years and 10 months in the second film. In the first film the 5 is in position over the E, apparently a little mesial to normal. In the second film, taken nine months later, after the 4 had been extracted, the 5 has come forward and occupies the position vacated by the 4, and the E is still quite firm and shows no signs of moving.

It seems to me that, in view of the work done recently by Professor Friel and others, this film may be of interest, and I should be glad to know whether other members have seen similar movements while the deciduous predecessor still remains firmly in position.

Professor E. S. Friel said he thought that any tooth which got a free way would go that free way, whether it was backwards or forwards. It would naturally go forwards if it had the opportunity to do so, but he thought that it would go backwards equally well.

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THE SECOND NORTHCROFT MEMORIAL LECTURE

The President said that at a meeting of the Council in 1945 Dr. Lindsay, during a discussion of what the Society should do to commemorate Dr. Northcroft, had said that, if in each year one of the seven regular meetings was called the Northcroft Meeting and a speaker of more than usual excellence was secured for that occasion, that in itself would be a sincere and fitting tribute to the founder of the Society and would keep his name and work before future generations. He was quite sure that when Dr. Lindsay made that observation she had no idea that she herself would give the second Northcroft Lecture, and he was also sure that her discourse would be a fitting tribute to Dr. Northcroft.

HEREDITY VERSUS PRACTICE

By Dr. LILIAN LINDSAY, C.B.E., LL.D., M.D.S., F.D.S. R.C.S. Eng., H.D.D., L.D.S. Edin.

FIRST I MUST EXPRESS my profound appreciation of the high honour you have conferred upon me by asking me to address you at this Northcroft Meeting, and my indebtedness to our first president Mr. Badcock for his valuable advice as to the construction of this paper.

The Council of this Society showed wisdom and foresight when they resolved that one meeting every year should be called the Northcroft Meeting, for this will ensure that our founder will be held in remembrance as long as this society exists.

In his inaugural address Dr. Northcroft said, " let us seek to harmonise divergent opinions." In an endeavour to follow this injuction I have chosen two texts from the Old Testament because they seem to me to express the eternal struggle of practice to endeavour to counteract the influence of heredity ; and also that they comprise the history of orthodontics. The first text is from the preacher, the pessimist, the worldly wiseman who said " That which is crooked cannot be made straight." The other is from the prophet, the optimist, whom Schopenhauer called the other-worldly wiseman who said " The crooked shall be made straight,"

That Dr. Northcroft was a man of wide vision is shown by his choice of a title for this society " the study of odonto prosopic orthopaedics " which, much to his regret, was replaced by the present title the study of orthodontics ; " as if " he said " mal-occlusion were the be-all and end-all of this study."

His Dental Board Lecture might be considered as his confession of faith for in it he dealt with his conviction that the study of the development of the whole body and the consideration of the normal, what it is and why, was the only way to attain to the understanding of the irregularities of the teeth.

This problem of the normal or, as the ancients called it the natural, has occupied the minds of philosophers throughout the ages. Hippocrates agreed that the heads of men were not all like one to another, and he laid it down that the bones should be measured according to the size of the head, not that all bones do arise from the head but because all bones should answer proportionably to those to which they are articulated. Works on anatomy generally started with shapes of the head and the " Fabrica " of Vesalius is no exception. Vesalius describes five different shapes starting with the natural. There were heads which bulged out at the back, others bulged out in front, and one belonging to a beggar in Bononia who had a head four square. Speaking of those heads which come to a point in front which he calls *acuminata* he says Thersites had such a head and mentions the Greek word used to describe it as " phosos " — a flame, (but he prefers the word oxycephalon).

Chapman's translation of that passage in the Iliad excites the same exhilaration as that described by Keats

" The filthiest Greek who came to Troy,
he had a goggle eye,
Stark lame he was in both his feet ?
his shoulders were contract
Into his breast, and crooked withal,
his head was sharp compact."

This is a good description of oxycephaly.

Writing in " Airs and Places " Hippocrates described a race living by the Sea of Azov whom he calls macrocephali because of their long heads which tradition ascribed to moulding at birth, because " they consider those the noblest who have the longest heads." Hippocrates argues, as if he were Darwin trying to convince himself that acquired characters can be fixed and transmitted " Thus at first usage operated and this constitution might be considered the result of force ; but after a time it became natural and usage had nothing to do with it." He proceeds as if he were the Abbé Mendel " for the semen comes from all parts, the sound from the sound parts and the unhealthy from the unhealthy parts and children with blue eyes are produced by parents with blue eyes, and if it be true of some parts why should it not be true of others and children with long heads be produced by parents with long heads ? "

Two thousand years later Emile Littré excavating in the Crimea discovered several tumuli containing skeletons of a race with peculiar heads, noticeable by the onlookers as well as the scientists, these heads were of extraordinary height compared with the base. Littré decided that these skeletons belonged to that race which Hippocrates called macrocephali.

It struck me when listening to Professor Harris last year that the genes carrying the characters of oxycephaly might have originated with these people and have been disseminated throughout the world, as suggested by Camper when discussing similar peculiarities, by the migrations of peoples, by shipwreck, by seafaring, by warfare and by trade.

There was Thersites among the Achaians in the Greek army, and the Achaians migrated into Greece from the North ; there was Pericles the great ruler of Athens whose head was a constant source of ridicule among the comedians ; Quintilian says " Pericles had an acuminated head, words thronging out not peacably as other men's." This gift of words is another feature, for although the words of Pericles were noble ones those of Thersites were " unregarded." There were those oxycephalics recorded by Vesalius and in this country in 1616 Helkiah Crooke mentioned in his ' Microcosmographia ' " Myself have seen a wondrous head in Lincolnshire like to the roof of a house neere to a sharpness all the way through, that boy was a foole and a wondrous great eater." He adds as if they were not uncommon " heads that are acuminated and like a sugar loaf have high roof of the palate." This agrees with the theory propounded by Professor Arthur Thomson in 1923 that when the bones of the vault of the skull are high the palate bones must follow. This is another feature of oxycephaly and is recorded in most of the reported cases.

It is possible that this excessive height of the palate may be the cause of the harsh voice often associated with oxycephaly. Thersites was :—

Fig. 1 (by kind permission of the Editor of *The Lancet*).

" A man of tongue whose ravenlike voice
a tuneless jarring kept
Who in his rank mind copy had of
unregarded words."

There were other historical figures who were noted for their " compact heads " for example the last king of France Louis Phillippe and his father Phillippe Égalité and there was Sir Walter Scott.

The first figure shows a Hindu with oxycephaly who was brought into the hospital at Bombay suffering from malaria; his goggle eyes attracted attention and a full report was made of his condition. He was otherwise well formed and intelligent, his palate was very high but the arch in front was good and the teeth were not crowded. There was a history of heredity in his family of this peculiarity. Park and Powers in America have collected records of 100 cases of oxycephaly. In some of their cases there were other peculiarities such as webbed fingers and toes, defects of the clavicle and elbow together with some of the other features of cleido-cranial-dysostosis such as shoulders folded across the chest as in the case of Thersites and supernumerary teeth as in the case reported in the *B.D.J.* by our President. In some of the skulls there was a sloping downwards of the floor of the orbit which the American authors decide is the cause of the protruding eyeballs.

I have emphasised this so-called abnormality which has been regarded as a dominant character, because it illustrates the persistance of the force of heredity and its influence heedless of sex, of race, of environment, or country ; there was a case as far away as Patagonia.

The same force of heredity is seen in other characters more familiar to the orthodontist, the prognathisms.

Parsons measuring Saxon skulls found superior prognathism such a constant feature that he decided that it must be a racial character. One thousand years before the Saxons this character was present in Egypt among the members of the eighteenth dynasty. Ahmose I, a powerful monarch who drove the Hyksos out of Egypt, is described by Ruffer as having a prognathous upper jaw and protruding teeth, a feature common to all the females of his line. The males also showed

Fig. 2

this prognathism as seen in his son, his grandson, his great-grandson and his great-great-grandson, Thutmose IV who shows this in a marked degree.

Fig. 3

When Alexander the Great conquered Egypt he left behind his great general Ptolemy Soter who, after the death of Alexander, became Satrap and later King. He was a great administrator as well as a great general, a patron of art, science and commerce and the founder of the famous library at Alexandria. His descendants show the inheritance of his features in characteristic fashion.

It would seem that the powerful lower jaw attended on the great for many of the outstanding figures in history have possessed it.

Fig. 4

William the Conquerer is described by his biographer as having a prognathous lower jaw and thick lower lip. He was strong mentally as well as physically, and may have inherited his jaw from his ancestress the daughter of the king of France who married the founder of the dukedom of Normandy, Rollo the Norseman.

Another strong character was Philippa of Hainault. There is a contemporary portrait of her by Bishop Stapledon who went to Holland. The bishop did not flatter the future queen when he said " the daughter of the Count of Holland is not uncomely ; her nose is smooth and even, save that it is somewhat broad at the tip and also flattened, yet it is no snub nose. Her nostrils are also broad ; her mouth fairly wide. Her lips somewhat full especially the lower lip. Her lower teeth project a little beyond the upper."

Fig. 5 (by kind permission of the Dean and Chapter of Westminster Abbey).

Through the courtesy of the Dean and Chapter of Westminster Abbey I have been able to obtain this photograph. The tablet on the tomb states that it is a portrait taken from life and it is evident that the sculptor has taken pains to show her projecting lower teeth. Phillipa was the daughter of William the Good, Count of Holland and Jeanne of Valois the daughter of the King of France, Phillippe le Hardi.

In 1911 a paper was read which has always remained in my memory, it dealt with mouth breathing and the Habsbourg jaw. This paper was by Mr. William Rushton, and I had the temerity to suggest in a paper in 1931 before this Society, that in their youth, as the Habsbourg's had adenoids, as shown in their portraits at that age, the constant throwing forward of the lower jaw to relieve this respiratory obstruction, caused stimulation at the temporomandibular joint and remoulding at the angle of the jaw, which Carl Breitner produced in Rhesus monkeys by intermaxillary traction.

This is well demonstrated in the contrast between the two lower jaws of Frederic III

and his son Maximillian ; the strong features of the father with the acute angle, with those of the son with the defective growth of the maxilla and the obtuse angle of the mandible. The portraits of the Habsbourgs show this adenoidal look and the open mouth described by Mr. Rushton.

Some of the Portuguese family showed signs of superior prognathism as in Catherine of Braganza whom Sir John Evelyn described " her teeth wronging her mouth by sticking a little too far out." John VI of Portugal had the short upper lip which exposed his centrals. There were other members who had the inferior prognathism of the Habsbourgs.

In all this strange eventful history the premaxilla has played many parts. It has had its exits and its entrances. Professor Brash at the end of his Dental Board Lectures said " It is suggestive that many of the true deformities and many of the worst irregularities of the teeth are in the region of the premaxilla which has a special developmental and evolutionary history."

The great impresario who introduced the premaxilla to the stage was Galen the idol of the world of medicine for 400 years. The passage referring to it in his works is so obscure that it has left a bone of contention for anatomists ; Goethe said that it must always remain in doubt as to whether Galen described the intermaxilla of a man or a dog. Vesalius, who was brought up in the Galenic tradition by the anatomist Jaques Dubois, sought to express his homage to the " Master " by illustrating his works. For this purpose he collected as much human material as possible. As he collected doubts arose which, when they became certainties that the premaxilla described by Galen was that of a dog, he published his findings. The medical world headed by Dubois, rose in wrath and words flew from both sides. At last Dubois who was a good anatomist, agreed as to the absence of the premaxilla from the human face, he capitulated and made an honourable retreat by saying that as Galen had described these bones as present in man's face they must have been there in his day but owing to increasing luxury they had been lost. Vesalius had the last word which has echoed down the corridors of time in that illustration in the " Fabrica " of the human skull superposed on that of the dog.

Fig. 6

Exit the inter or premaxilla for the next 200 years. Cheseldon does not mention it neither does so acute an observer as John Hunter. Camper who dissected the heads of infants and very small embryos declared that the premaxilla did not exist in man.

It was left to the great poet Goethe to re-introduce it. He described it in a classic article " there exists an intermaxilla in man as well as in animals." Goethe traces this element from fishes up to man and gives the most detailed description of these bones. He shows its struggle for existence in the faces of the different species and that its presence waxes and wanes according to the function exercised by the teeth in the front of the mouth. In those animals where the greatest force falls upon the incisors, as in rodents, there the premaxilla is best developed. It is mightiest in the mightiest as in the elephant. In the carnivores where the greatest strain falls over the carnassial teeth it is not so well developed ; in the horse it is quite slender for the chief stress falls over the molars and in the ruminants it is weak and furnished with cartilage instead of teeth.

In the extensive work of Leuckhart there are many illustrations especially of embryos in which it can be seen that there

are differences on the two sides of the maxilla in the time of calcification of the premaxilla which may be the reason for some asymmetries. Leuckhart mentions that in fishes with one eye the premaxilla is rotated towards the blind side on which it is absent but when there are two eyes the premaxilla is equal on both sides. In a human skull showing complete eruption of one central and only partial eruption of the other there is, on the defective side, a spur of bone sent out from the premaxilla into the nose.

Professor Wood Jones has made an exhaustive study of these bones and the narial margins in man. He considers the absence of the premaxilla from the human face is an attribute peculiar to man which in the course of evolution has marked him off from the rest of the animal kingdom. The early coalescence of the premaxilla with the maxilla (4th week of intrauterine life) is evidence of its early phylogenetic acquirement. The reduction of the muzzle the elevation of the nasal bones, and the down growth of the maxilla have forced the premaxilla out of the face until it is a thin layer of bone over the sockets of the incisors.

Callender in a communication to the Royal Society mentioned a maxillary clip coming forwards in front of the premaxilla and so shutting it out from the face and at the same time obliterating any suture that there was between maxilla and premaxilla.

That marked feature in man the anterior nasal spine is formed during this process of obliteration, by the maxilla. This spine measures 5.5 mm. in Europeans, in the more prognathous 4.4 mm., in the Mongols 4 mm., in Australian aborigines 3.3 mm., and in Negroes 2.6 mm. The narial margins in the last three races are double and show a gutter and the nasal aperture is wide. Sir Arthur Keith drew attention to a point which he says he has not seen observed previously that at the 5th year the surface beneath the anterior nasal spine starts from the premaxillary element but that in the adult it starts from the anterior palatine canal, which process he likens to the cutting back of the anterior border of the ascending ramus of the mandible.

From time to time at rare intervals there are claims put forward of congenital absence of the premaxilla. Fischel describes a female skull in which the sagittal suture is obliterated and the appearance of the whole is hyperorthognathous. There are only the canines present in the front of the mouth which are separated by 8 mm. by a knife edge of bone there is no anterior nasal spine but the so-called foramen incisivum is present. The canines are sharply rotated so that their labial surfaces are turned to the anterior or mesial surfaces of the premolars ; the arch has lost its keystone. Sir Frank Colyer, to whom I am indebted for the suggestion to study this element and who has helped me greatly, has proved that some of these cases which appear to the casual observer as instances of congenital absence are in fact early cleft palate operations in which the premaxilla has been removed. Sir William Fergusson advocated this operation in cases of double cleft palate to facilitate the union of the two sides of the maxilla. Other cases have been recorded in the Journal of Anatomy but as Sir Frank Colyer pointed out these skulls show evidence of severe infection and in all likelihood the premaxilla has been exfoliated

A, anteria ; B, external ; C, internal view of the intermaxillary bones.

Fig. 7

as in the case recorded by Bryant in the Proceedings of the Pathological Society in 1858 of a child of four years after an attack of measles the whole of the premaxilla was exfoliated Bryant says, "The bones are the most perfect specimens I have ever seen."

Kolliker suggested that deficiency of the premaxilla was one of the causes of open bite.

In this study of the intermaxillary-maxillary suture Sir Frank Colyer will be remembered by the paper he gave to the E.O.S. in 1936 on " The Pathology of the Crowded Mouth," in which he showed as the result of study of the skulls in the R.C.S. museum that when the suture is closed at the age of 4 years there is crowding of the teeth, but that when it is open there is that much desired spacing of the milk teeth and the hope of regular teeth in the successors.

On this subject Professor Brash remarks " the true explanation of that relationship will, I believe, be found in general considerations of the relation of sutures to growth and particularly in the evidence that sutures tend always to close but are always in a constant state of reformation as surface growth takes place, evidence which points to the conclusion that the closure of a suture is not the *cause* but the *result* of a cessation of growth."

This is the case for the preacher. What have the followers of the prophet to say ?

It is to that restlessness, which has marked him out from the beginning that man owes any progress he has made. His dissatisfaction with deviations from the straight and his desire to rectify them, is shown in stories of the loss of paradise. The flood story, that first experiment in eugenics was a determination to exterminate the unfit and to begin afresh by breeding only from the perfect in mind, body and estate.

The years flowed on into the centuries and deviations from the perfect appeared once more stimulating man's ingenuity to devise means for their rectification. Sophocles observed this when he wrote :—

> *All fertile in resource, resourceless never*
> *Greets he the morrow ; only death he wants the skill to shun*
> *But many a fell disease the healer's art hath foiled*
> *So soaring far past hope the wise inventiveness of man*
> *Finds diverse issues ; good or ill.*

Towards the end of the 17th century a stalwart supporter of the prophet appeared in the person of the great Pierre Fauchard who announced that " the crooked *shall* be made straight." and proceeded to show his faith by his works. He met with the same excuses against repeated visits to the orthodontist as are offered today, that is, lessons and masters. These excuses did not deter Fauchard, he collected a few spectators and armed with his pelican he dragged the errant tooth into position to the amazement of all who beheld it. The other method was to tie the tooth or teeth to a strip of metal, gold or silver, and to renew the ties, tightening them every day. It is an error to call that piece of metal an expansion arch, for expansion never entered Fauchard's head. When the space was not large enough for the irregular tooth he made it large enough by filing the adjacent teeth. There was a prevailing opinion that filed teeth did not decay and lasted longer than those which are not so treated.

That habits and posture are responsible for irregulatriies is no new idea, for Camper relates that it was held that Dutchmen had long heads " because they lie upon their temples or their sides, and that Germans have round heads flat at the back because they lie upon their backs." " A particular manner of sitting or lying, of standing or walking, various corporeal defects and other circumstances of the like nature give a particular cast to the whole body. This is so obviously the case that the countenance of a deformed person will become deformed, that is it sinks gradually by the pressure of the brain which has now lost its equipoise. Thus the socket of one eye sinks lower than the other."

These defects were treated then as now by physical exercises in academies and colleges equipped with suitable appliances.

It was natural that irregularities of the teeth should attract the attention of John Hunter who was the first anatomist to devote an entire treatise to the natural history and diseases of the teeth. His experiments on the growth of bone led him to state that after the eruption of the full temporary dentition growth ceased in that part of the jaws and that if it had not been sufficient to accommodate the permanent successors there would be irregularity in that part especially the upper. To counteract this lack of room he suggested the extraction sometimes of the bicuspids sometimes of the first permanent molars " before the temporary grinders are shed."

He did not however ignore that room could be made by mechanical means and made the profound observation " the very principle upon which teeth are made to grow irregularly is capable, if properly directed, of bringing them even again. This principle is the power which many parts (especially bones) have of moving out of the way of mechanical pressure."

In this work there is the first suggestion as to expansion which may not have been original since it is certain that Hunter worked with James Spence, Hunter says " if a cross bar was to be stretched from side to side across the roof of the mouth between cuspis and cuspis it would widen the circle." He goes on to say that the teeth may be ligatured to this but that it is troublesome.

All this time inventions multiplied but it is evident that only fixed appliances were used.

We read of the little Empress of Brazil shedding tears as Cartwright tightens the braces on her teeth and she is told that royalty must learn to suffer and be strong. Mothers exhorted their weeping daughters " il faut souffrir pour etre belle." The force applied seemed to increase with the passage of time.

Kneisel in 1836 published a book devoted entirely to irregular teeth. He made an attempt at rough classification of these irregularities. He was meritorious in that he took impressions of the mouth and cast models from these. For some inscrutable reason he poured them first in sulphur before plaster and afterwards in fusible metal, with counter die.

All this in order to strike up a cap to which to attach a spur to bring an instanding tooth into line. Six years later Schange in 1842 published another work on irregularities. He deplored the early extraction of the temporary molars and like his modern successors attributed many of the irregularities of the permanent teeth to this operation. He devised cribs with occlusal rests to prevent the cribs from slipping into the gum. To these cribs he soldered hooks for elastics sometimes on both sides buccally for the retraction of outstanding incisors.

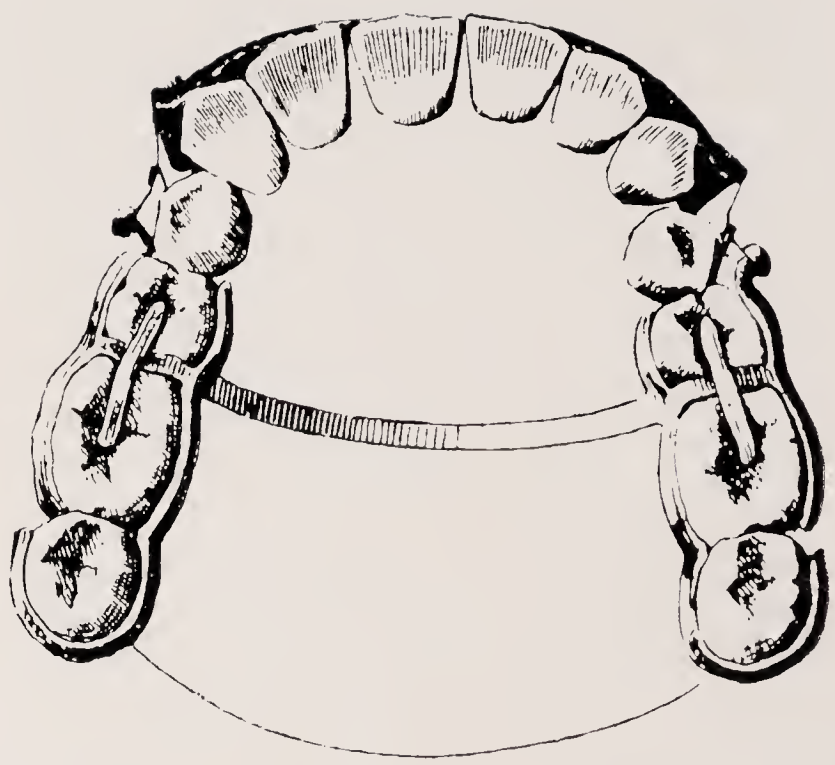

Fig. 8

Materials have had a notable effect upon the treatment of irregular teeth ; carved bone plates were suggested by their use for artificial teeth, indeed the whole practice has been copied from the mechanical training of the dentist in prosthetics. John Tomes mentions bone plates tied in but fitted with hickory pegs for pressing upon instanding teeth and it was not until the introduction of vulcanite that removable appliances came into use. It was about that time that Coffin introduced his expansion plate a split plate with a powerful piano wire spring in the centre, and piano wire became a favourite for springs.

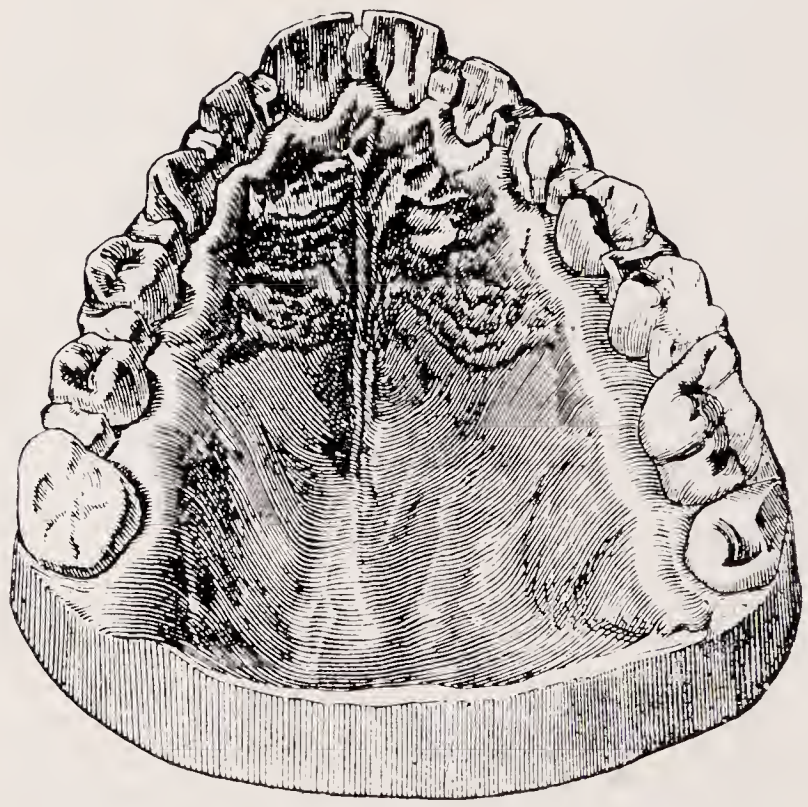

Fig. 9

Sometimes another method was employed for expansion by wedges, Norman Kingsley says " Wedges are also an important source of power." " By the proper adjustment of wedges they can be made to do more in the length of time than all screws, pulleys, levers or inclined planes." The rapidity with which this method worked is illustrated by the fact that in twenty days upper teeth in lingual occlusion could be forced into normal occlusion. Wedges were inserted between all the teeth. That this sometimes led later to disastrous loss of all the teeth with other more unfortunate

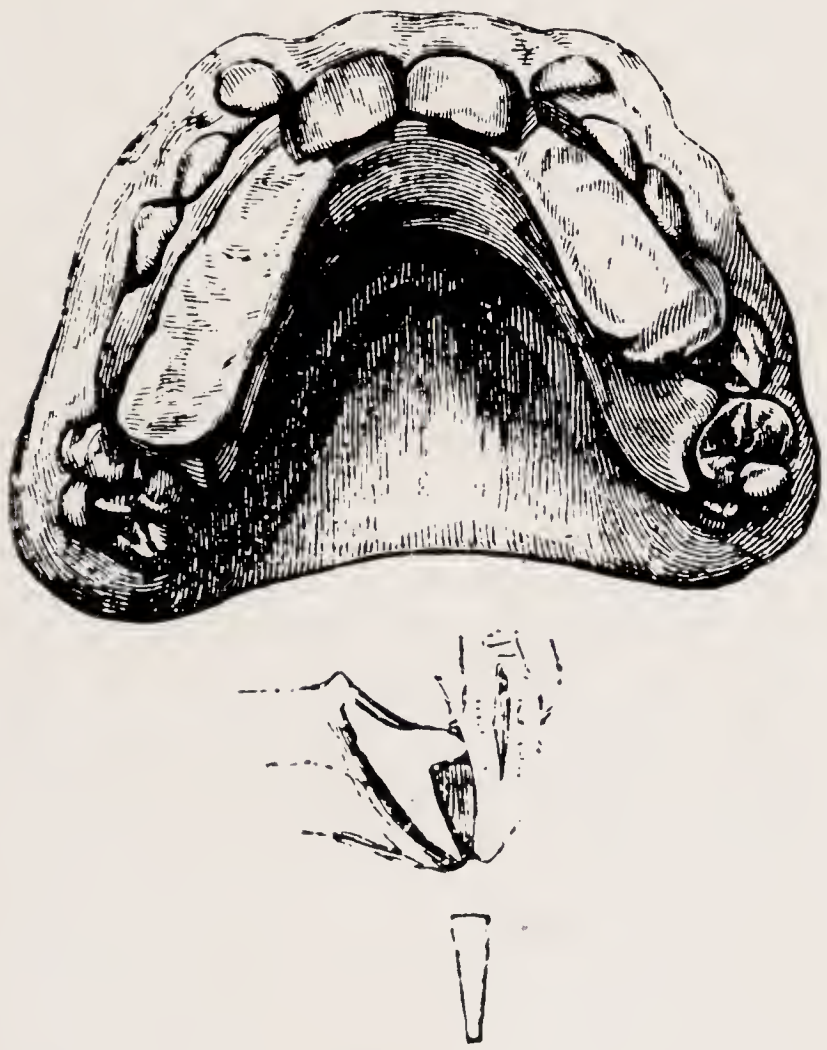

Fig. 10

results, has been recorded. Kingsley claimed " The individual features being naturally well formed and symmetrical the change in their relations produced a face of more than usual beauty." As the practice of this drastic measure seems to have died out it is evident that its dire effects were recognised.

Carabelli seems to have been the first, to classify occlusion, this was into eight classes mordex normalis, mordex rectus, mordex apertus, mordex prorsus, mordex retrorsus, mordex tortuosus, mordex senilis, os senile. To these we may now add a ninth from Professor Friel's classic work on occlusion, mordex infantile.

The mention of occlusion naturally brings to mind the name of Edward Angle who reduced these classes to three with divisions. His powerful personality in the world of orthodontics occupied the same position as did that of Galen in the world of medicine.

Perhaps his greatest claim to fame was as the first to establish a school for training orthodontists, not a mere post graduate course, but a full specialist education for the practice of orthodontics. Students resorted to this school from all parts of the world and in this way his teaching became almost universal, and he was a bold man who would gainsay that teaching. Such a man was William Rushton who showed (contrary to Angle) that beauty of face could exist associated with malocclusion, and that the retention of the full complement of thirty teeth so far from enhancing may mar that beauty.

The great psychologist and physiognomist Dickens emphasised this with wearisome reiteration in the character of Carker in Dombey and Son " An unbroken row of gleaming teeth whose whiteness and regularity were quite distressing . . . his smile had something in it of the snarl of a cat."

Nevertheless the followers of Angle held extraction of a tooth a violation of the laws according to Angle. So great was that influence it engendered a kind of bigotry among his followers and when Mr. J. H. Badcock went to the Orthodontic Congress in 1926 to read a paper on the value of extraction in the treatment of irregularities he was regarded as bearding the lion in his den.

Mr. Rushton held that mouth breathing was responsible for much irregularity and Warwick James, Northcroft and Dickin designed mouth screens for wearing at night.

Robin with his monobloc and Andresen with his Norwegian system are of the same category.

Outstanding among those who base their treatment upon the laws of the physiology of the tissues is Sim Wallace,

who gave fresh impetus to treatment by prevention by insisting on natural feeding from birth onwards. Breast feeding is the great stimulant to growth at the maxillary intermaxillary-suture keeping the suture open by a stimulus to surface deposition. In this Dr. Wallace is supported by the observations of Sir Frank Colyer that the wise encouragement of mothers to give their infants bones to gnaw and tough things to chew as soon as the teeth have erupted, and the abolition of slops from the diet of the young, may encourage the crooked to become or to grow straight.

In spite of all this milder teaching, drastic measures held the field until there came a warning voice as to the effects of so much force upon the supporting tissues, when Albin Oppenheim published the results of his researches. Then came the war 1914-18 when orthodontics went into abeyance. Once more materials brought in a revolution in appliances, the introduction of stainless steel made possible the adoption of the milder methods advocated by Oppenheim and gave orthodontists with the ingenuity of Professor Friel the chance to exercise it in devising delicate springs which would act gently but continuously and avoid the dangers enumerated by Oppenheim.

For many years Mr. Chapman has urged the study of the normal and those seeming divergencies from it which are merely phases in normal development ; in so doing he was bringing into remembrance the maxims of Fauchard that it requires great experience to know when to operate but much greater experience to know when not to operate.

Taking a survey of the whole field of orthodontics, and particularly that part of it which concerns aetiology, it is a matter of pride to reflect that the most important contributions in that sphere have come from our own anatomists John Hunter, Sir Arthur Keith, Professor Wood Jones and particularly Professor Brash in his Dental Board Lectures and when he summed up in favour of heredity, a distinguished orthodontist exclaimed " Yes but hang it all we have to treat these conditions."

It is in that treatment that reconciliation may be found between the followers of the preacher and those of the prophet, by natural feeding, by judicious extraction, by those saner methods of treatment evolved after long research, by surgery in those grosser forms of malocclusion, surgery both operative and plastic with the aid of prosthetics, (even oxycephaly has been successfully relieved by surgery) or it may be by those methods shadowed forth in the inaugural address of our President, that the last part of the prophet's sentence may be fulfilled " and a highway shall be there."

* * * * *

DISCUSSION

The President said that he had listened with amazement and admiration to Dr. Lindsay's Lecture, which covered many centuries and embraced the subjects of history, comparative anatomy, philosophy and technique.

It was always fascinating, he thought, to look at the faces of the old kings and duchesses. Certainly their faces were not their fortune, but in spite of that they came to the fore. There was no end to the argument about the Habsburg jaw. It might be said that the lower jaw came forward because breathing was obstructed, or it might be said that breathing was obstructed because the upper jaw was small, and there were many other theories about it. He thought that Dr. Lindsay's explanation was as satisfactory as any that could be put forward.

The message which Dr. Lindsay gave at the end of her Lecture, with regard to the difficulties which all orthodontists felt when they were faced with genetic abnormality was, he thought, a very helpful and useful one. He believed it was absolutley true that there was no real reason why orthodontists should not lack attempt to treat an abnormality however strong a genetic background there might be.

They should not be discouraged by genetic abnormality but should only try harder.

Professor E. S. Friel said he was sure everyone present must be filled with admiration for Dr. Lindsay, who had spoken for an hour, without a note, on a very wide range of subjects, giving names and dates one after the other without the slightest hesitation. He thought it was a marvellous achievement.

In the early part of her Lecture Dr. Lindsay had referred to the disappointment felt by Dr. Northcroft when the name which he had proposed for the Society had not been adopted. It should be remembered that the Society had been founded forty-one years ago and that Dr. Northcroft had probably been twenty years ahead of his time. If the Society had been founded at the present time, the name proposed by Dr. Northcroft might have been adopted.

In 1922 the Society had appointed a Committee to consider and report on the subject of orthodontic education, and Dr. Northcroft had been one of the members of that Committee. One of the first things in the actual programme or syllabus proposed was a definition of orthodontics, and he thought that Dr. Northcroft was mainly responsible for putting forward the best definition of orthodontics that had ever been given. Personally he thought it ought to be set out at the beginning of every volume of the Society's Transactions. It was so worded that each subject was in its proper order, the most important first and the least important last. The definition was as follows: "Orthodontics includes the study of the growth and development of the jaws and face particularly and the body generally as influencing the position of the teeth" —that was the study of the normal—"the study of the action and reaction of internal and external influences on this development"—that was the aetiology—"and the prevention and correction of arrested and perverted development." It would be noticed that treatment came last, as the least important factor.

The history of the premaxilla was a very interesting one. It had been discovered, then it had disappeared for seven hundred years and then it had been rediscovered. Sir Frank Colyer's observation about the premaxilla closing and the incisors being irregular was a very important one, and Miss Clinch had pointed out to him that in some of the cases in which the incisor erupted and knocked out the deciduous lateral and the deciduous canine there was a sinking in of the face, as if the premaxilla on that side had closed earlier than the corresponding premaxilla on the other side. No one knew what caused these conditions, and the knowledge of the ætiology of anything that could really be called a maldevelopment was very small. He thought it was only now that the ætiology could be studied, because there was now a basis for that study in a knowledge of the growth of the jaws which had not been available thirty years ago.

It was difficult to forecast the position that Angle would occupy among orthodontists in future generations. Angle had had an enormous influence on orthodontics in his time, and one of the most important things he had done was to found a school, which attracted the best teachers and for which he selected a small number of students from hundreds of applicants. When those students left the school and started work they believed all that Angle had told them, but they very soon discovered that some of the things they had been taught did not work out in practice, and a great deal of the progress made in orthodontics was due to the pupils whom Angle originally taught.

Angle was an idealist, and it was a very good thing for a teacher to be an idealist, even if his ideals were not absolutely right. He was also an excellent mechanic. Extremes of any sort, in orthodontics as in other matters, could do a great deal of harm, and the moderates probably did the best work, but they did not catch the popular votes.

He thought the Society had shown great foresight in inviting Dr. Lindsay to give the Second Northcroft Lecture. No one else had the knowledge required for the production of so fine a historical Lecture, and he was glad to know that it would be published in the Society's

Transactions, so that future generations could read it.

Dr. Lindsay, in replying to Professor Friels' remarks, said that she had omitted certain parts of her Lecture on the present occasion, but it would be published in full, and it would then be seen that she mentioned that investigations into embryo skulls had shown that in some cases the intermaxilla ossified earlier on one side than on the other, and that might account for some asymmetries of the face. It would give one side of the face an advantage over the other in growth.

In regard to the teaching of Angle, his influence had been a very powerful one, but when his students went out into the world of realities they had realised that there were conditions which were not fulfilled by following his teaching. Angle had done a very great deal towards making orthodontics a science ; he had laid the foundations on which others could build, and she thought that the building was now being done in the right direction. Angle had stirred up a desire in others to understand irregularities.

On the motion of the President, a vote of thanks was accorded to Dr. Lindsay and Mrs. Michaelis, and the meeting then terminated.

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PRACTICAL OBSERVATIONS

By HAROLD CHAPMAN, F.D.S. R.C.S. Eng.

I HAVE RECENTLY URGED some of my younger colleagues, who, I feel sure, have access to the necessary material, to present communications to this Society and have been surprised to receive the reply that it is a purely orthodontic society and that anything read must attain a particular standard. Whilst frivolous presentations would be frowned on, the majority of members (the Society exists for these as well as others) are not expected to read papers of the character of four presented this year, the President's (Professor Martin Rushton) address: "*Some Aspects of Antero-Posterior Growth of the Mandible*,"[1] Dr. Scott's: "*The Development and Growth of the Upper Jaw*,"[2] Dr. Lindsay's: "*Heredity v. Practice*"[3] and Mr. Pringle's account of his visit to the United States.[4] Such require special opportunities not universally available, but many could find the opportunity to make an investigation such as Miss Clinch's: "*Variations in the Mutual Relationship of the Upper and Lower Gum Pads in the New-Born Child*"[5] and Mr. Rix's: "*Deglutition and the Teeth.*[6] The two latter deal with clinical findings and *all* who practise orthodontics have these and their experience to present. Examples of subjects for investigations are:—

1. Changes in untreated cases, normal and abnormal.
2. Mrs. Muriel Davis[7] writes that the normal developmental position of the lower laterals is lingual to the lower centrals; I believe the distal edge may be lingual or labial to the lower deciduous canine: this may not conflict with Mrs. Davis' experience but amplification seems necessary.
3. Why teeth are irregular when there is ample room for them or room for them to be in better line than they are, e.g.,
   i) An upper central may be in marked proclination whilst there is ample room for it in good alignment; in one case this applied to the two permanent upper laterals (*Fig.* 1). Many teeth frequently improve their alignment naturally, whereas the teeth I have in mind do not—why? Has their position, "proclination," anything to do with this problem?
   ii) Recently I have seen many rotated upper canines for which there is sufficient space (or space for them to be much "straighter" than they are).
4. Is breast feeding essential to ensure normal occlusion?
5. Do tonsils and adenoids have any effect on arch form and size?
6. Is the position of the mandible in relation to the maxilla changed in cases of Angle's Classes II and III when treated by intermaxillary traction, or is it only the teeth that are moved? Mr. Hovell and Mr. Ballard[11] think the latter. I have always assumed it was the former. *Figs.* 3, 4 and 7 are cases in which the mandible has changed in relation to the maxilla.
7. Results of treatment—unsuccessful ones being more important than successful ones.
8. Trauma as a result of bands. Is it not remarkable that a band $\frac{3}{16}$" wide, slightly narrowed medially and distally on the gingival margin, can be fitted on a permanent first molar at nine years of age without discomfort though the soft tissues distally are on a level with the occlusal surface? Does this involve severing the epithelial attachment? I have frequently noticed on removal of a band from a permanent lower molar that the gum margin is not tightly adherent to the tooth—the gingiva reminds one

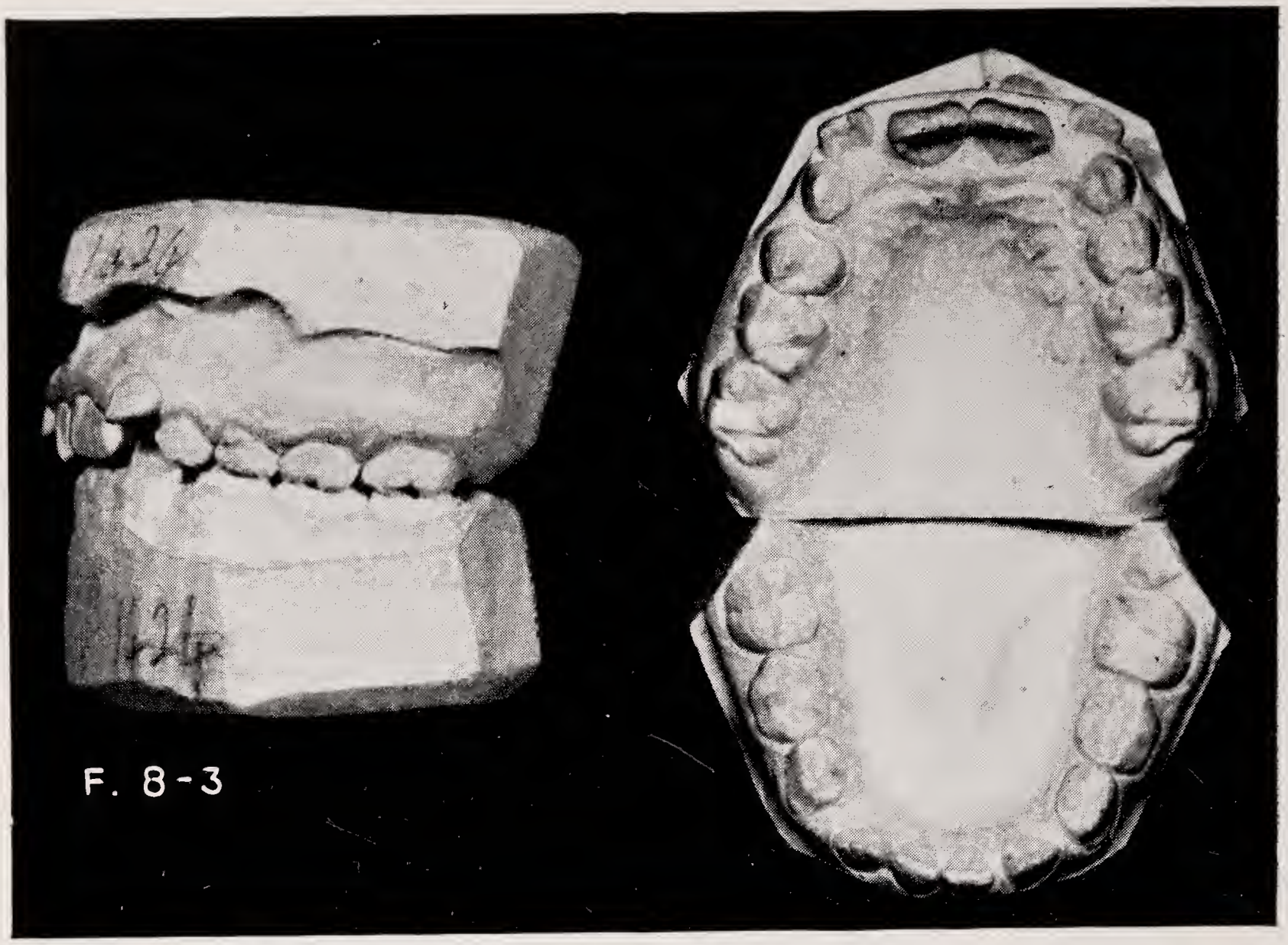

Fig. 1. Case No. L. H. 1424. F.

Shows an upper arch in which the spaces for $\underline{2|2}$ *are sufficiently large for these not to be as proclinated and labial as they are.*

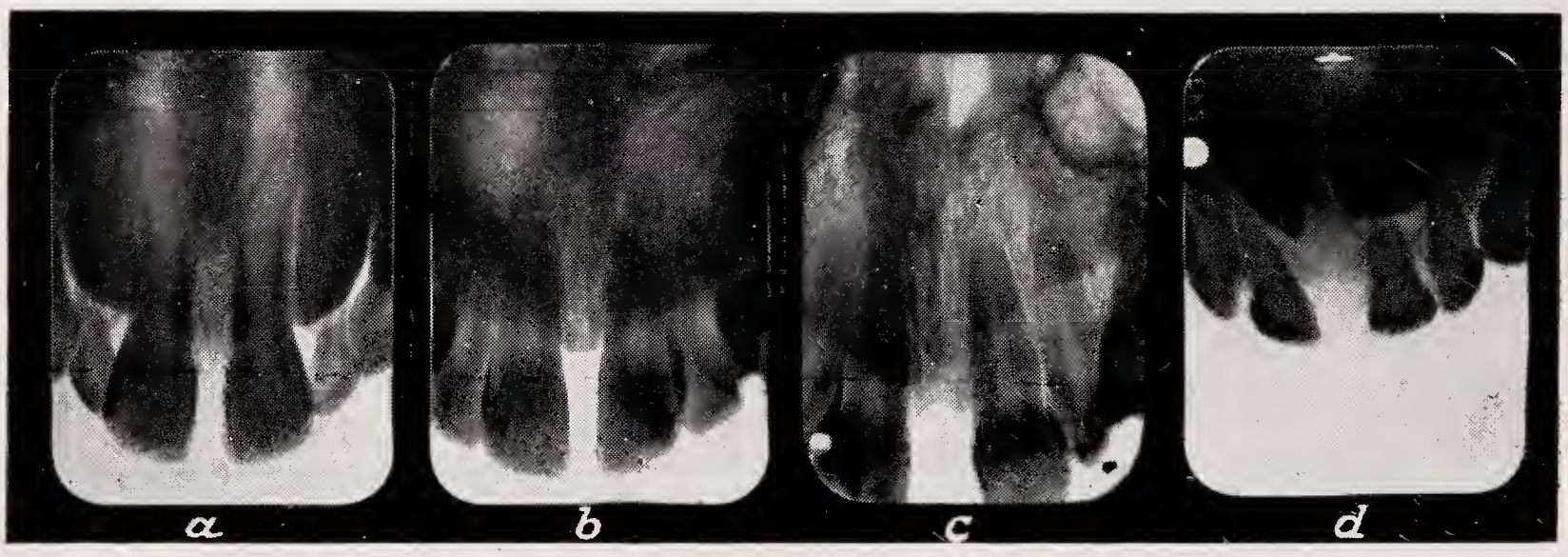

Fig. 2.

Fig. 2a. *Separation of* $\underline{1|1}$ *with normal condition of the bone between, Age* 10-0.

Fig. 2b. *Separation of* $\underline{1|1}$ *with abnormal condition of the bone between, probably permanent separation. Age* 18-0.

Fig. 2c. *Girl age* 18-0 *with separation of* $\underline{1|1}$ *; these had been brought together and relapsed. Bone condition between* $\underline{1|1}$ *is similar to that shown in Fig.* 2b.

Fig. 2d. *Similar bone condition to that shown in Fig.* 2b *and Fig.* 2c. *Age* 5-4. *Will* $\underline{1|1}$ *be separated permanently ?*

The writer is indebted to Mr. O. N. Catchpole for radiographs (a) *and* (b) *and to Mr. Kenneth Wright for* (c).

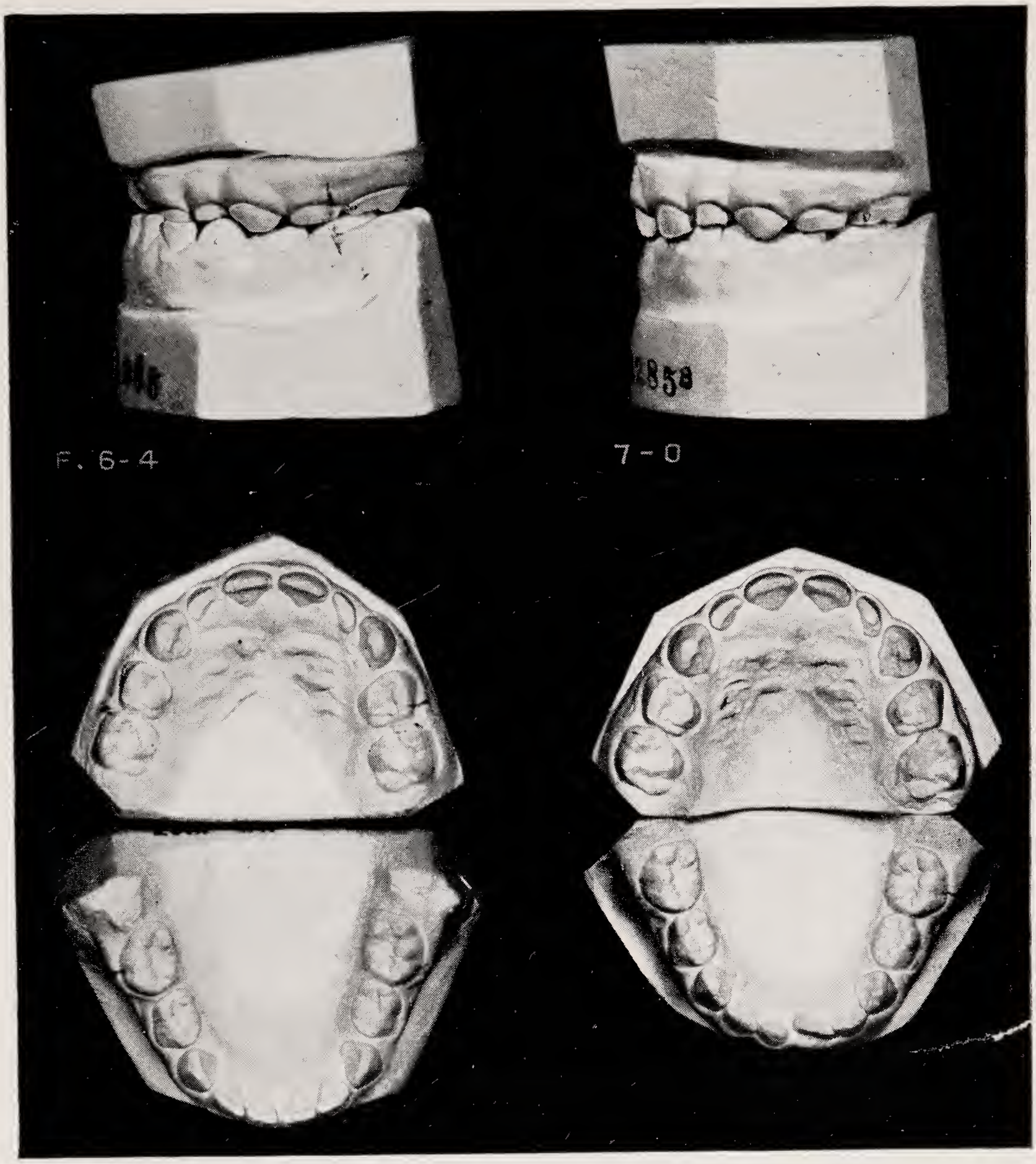

Fig. 3. Case No. 4285. F.

Age 6-4. *Dentition* edcba | abcde *treated with head and chin cap for five months and a lower plate, covering* $\overline{ed}\,|\,\overline{de}$, *combining an incline plane for the upper incisors to occlude on ; there was no contact with the upper molars. This plate was worn for two months. Result very satisfactory. Note relation of* $\overline{ee}$ *to* $\underline{|\,ee}$ *at* 6-4 *and* 7-0.

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of a flap ; does it later hug the tooth as it would had it never been banded? Is this a sign of deterioration or " ageing " of the supporting tissues ? In addition, the strain put on anchor teeth may be a factor which tends to shorten their life or to bring about a pathological condition.

These considerations lead me to believe the use of the second deciduous molars for anchorage is to be preferred to permanent molars in

case bands are harmful to the latter. Appliances, which include multiple bands whereby teeth are held more or less rigidly, also may be harmful to the supporting tissues.

Two examples of the importance of clinical experience as a basis for treatment, rather than theories or empirical belief, are :—

i) Expansion of small arches (as in typical Angles' Class I cases) which will not develop naturally and cannot be developed by appliances, to contain all the teeth in line *permanently* : (there are certain cases in which expansion is good treatment). Angle taught enlargement of the arches in these cases so successfully that it is widely followed to-day, and one young practitioner told me that he must learn by his own experience to be convinced that such treatment is not successful (it took me many years to learn this). Watry[8] comments : ". . . any attempt to escape from these conceptions was considered a heresy."

ii) The bringing together of the upper central incisors—I did this frequently but have abandoned it entirely (but I do not think it has been abandoned generally) believing that they come together naturally, or if they do not, whilst they can be brought together, they will not remain so (*Fig.* 2).

These examples make it evident that confirmation, or otherwise of theories and beliefs is necessary to arrive at the truth and to convince the profession : to quote Watry[8] again : ". . . facts alone have any value : " all can play a part in eliciting these and having done this, they need to be broadcast with as much propoganda as heralded the original error, if such there be.

It follows that clinical experience is one type of research and a very valuable one : every practising member is gaining experience daily and in so doing is performing research work. Clinical experience puts theories to the test ; the last word has not been said, otherwise we should not have the number of " new treatments " which appear regularly in the literature, and are a sign that what had gone before has not given entire satisfaction. Let me add, too, that unsupported statements in the text-books, are the teacher's " *Bete-noire* " : these statements may be handed down from one author to another, the last quoting previous authorities, thus giving an appearance of unqualified support for some statement which the student accepts : it is with difficulty he " unlearns " the written word. Here are fields in which the clinician has valuable work to do. Clinical experience is the court of final appeal. Each case is a problem different from all others, and so interest is sustained. Is not this one of the reasons given for the present-day popularity of orthodontics.

One who is going to use his clinical material for publication must proceed on organised lines. I mention this because when we start in practice cases are few—we remember all about them ; but the time soon comes when all material must be kept in meticulous order, if it is to be of use in the future. For example, models numbered and bearing date and age of patient : X-rays filed : cases classified according to their (i) etiology, (ii) diagnosis, and (iii) under any other headings the operator chooses ; lantern slides, radiographs and photographs must be similarly treated and classified under the various headings of the points exemplified and cross references made. This entails some work, but the trouble is essential and well worth while if one is interested and anxious to make the most of his material ; I wish I had been advised how to proceed when I began, instead of developing a system of recording piecemeal. Also, it is worthwhile to file material of orthodontic interest from the current journals which are not devoted entirely to orthodontics. I have not found the headings in " Index to Dental Periodical Literature " or " Fondation Documentation Dentaire " sufficiently comprehensive : a considerably amplified dental index is needed for the material to which I have referred : it is to be hoped that this task will be undertaken in the near future : is there sufficient interest for a committee to report on it ?

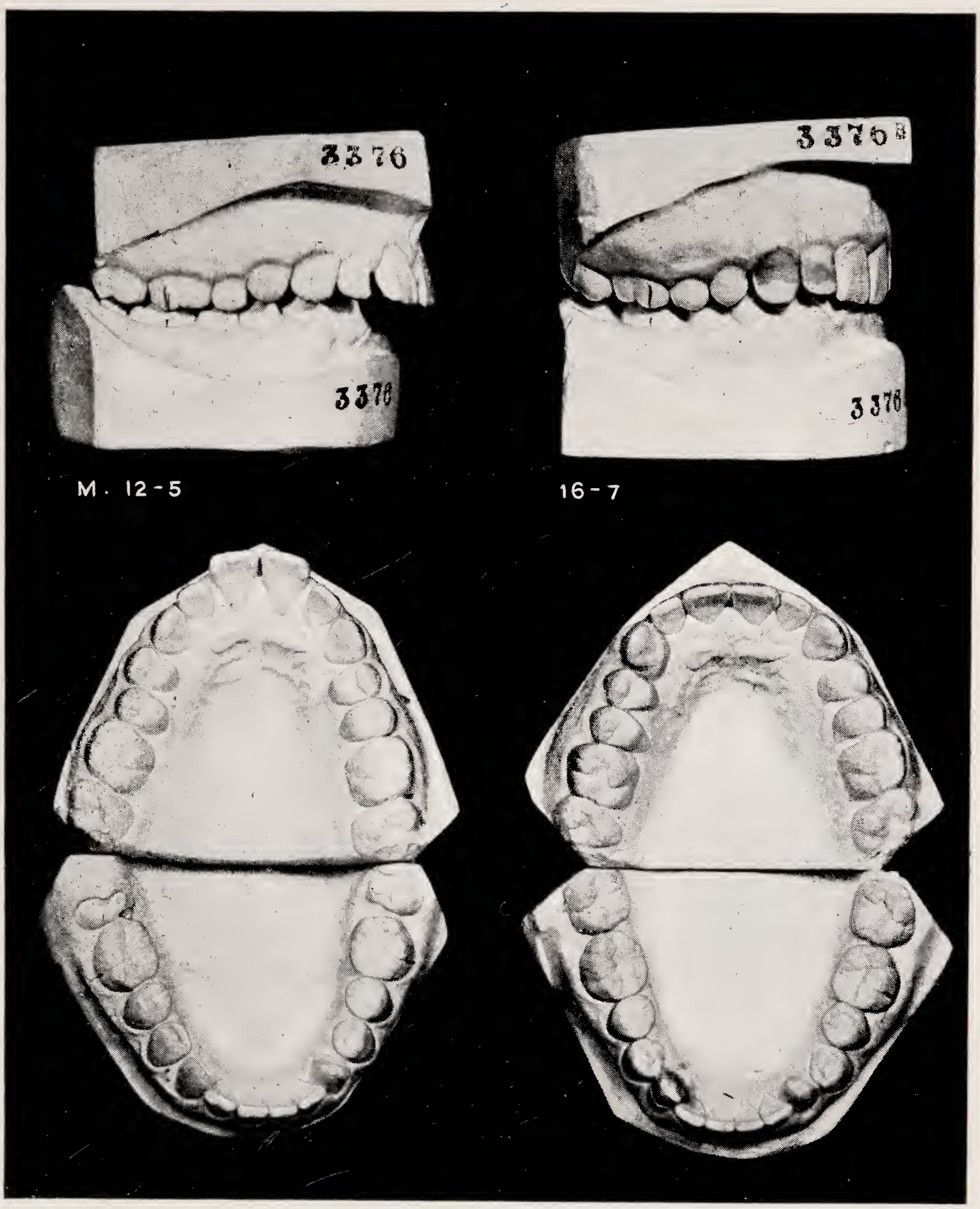


Fig. 4. Case No. 3376. F.

3¼ years treatment with fixed appliances and intermaxillary traction. Last models (age 16-7) show the condition nine months after all apparatus removed.

Figs. 3 *to* 7 illustrate cases which have a bearing on points I have raised, and notes on these follow :—

Skeletal Pattern. (*Figs.* 3 *and* 4).

This is an expression which I take to refer to size and shape of the dental arches

Fig. 5.

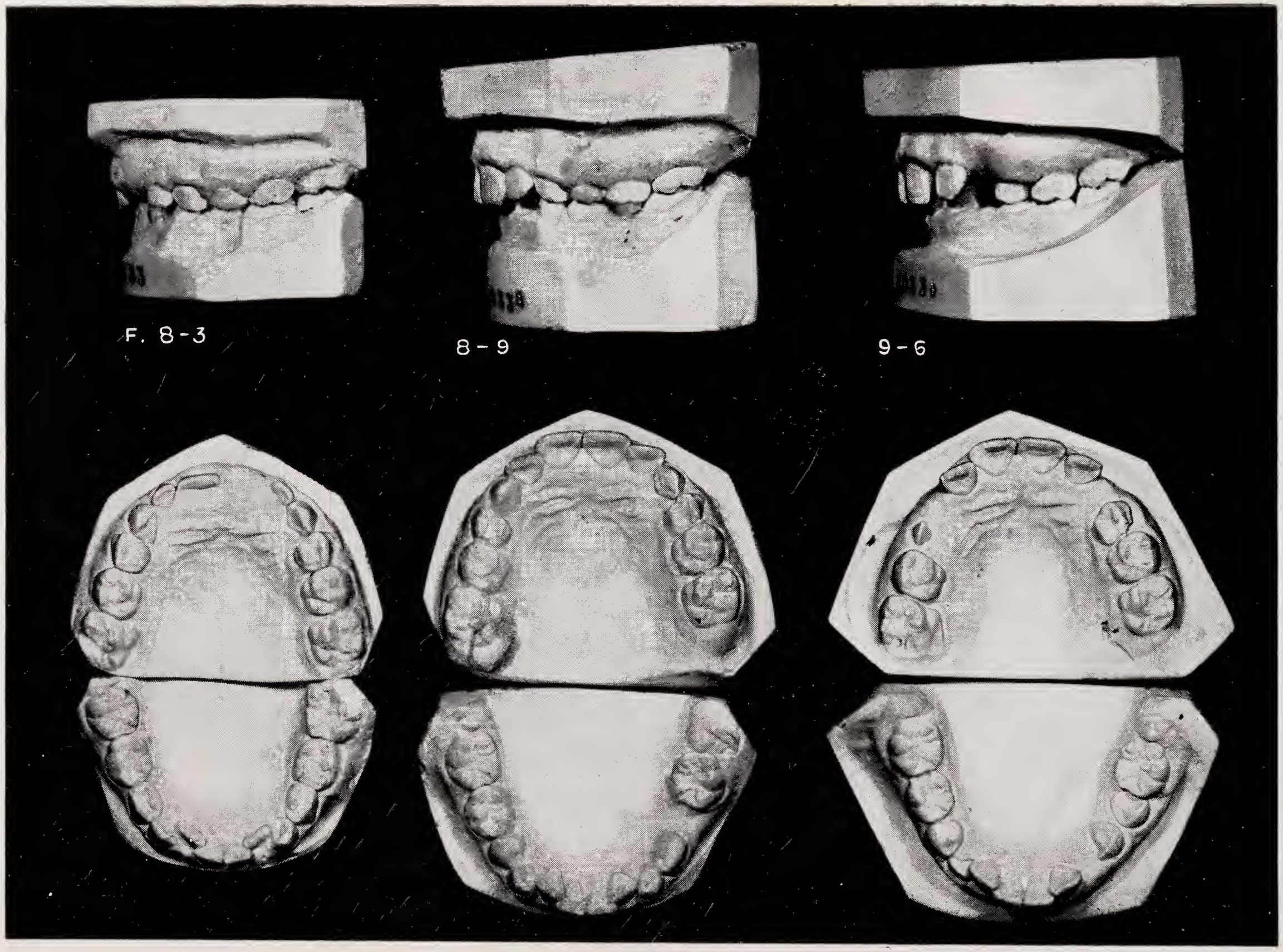


Fig. 5. *Case No.* 4033. F. (*opposite*).

Age 6-11 *normal arch relation but with Class II tendencies, that is to say with post normality and excessive overbite ; therefore important the lower arch should not be allowed to go smaller. Space* $\lceil\overline{e}$ 9.75 *mm. Age* 8-9 *Space* $\lceil\overline{e}$ *reduced to* 6.25 *mm. after loss of* $\lceil\overline{e}$. *Age* 9-6 *After treatment, space* $\lceil\overline{1\text{-}6}$ *restored to* 26.5 *mm. which it was at age* 6-11, *but reduced to* 24.5 *mm. at age* 8-9. *There are developmental changes occurring as well as those resulting from early loss of* $\lceil\overline{e}$ *which may affect the measurements which are the actual measurements. The loss and restoration of space is seen in the illustration. Lower plate used to move* $\lceil\overline{6}$ *distally, Visick clasps* $\overline{e}\rceil\overline{d}$: *to the* $\lceil\overline{d}$ *clasp buccally is soldered the free end of a loop which passes distally to* $\lceil\overline{6}$, *returning to be inserted into the plate lingually. On the buccal aspect of the loop is soldered a combined coil and loop spring ; the distal end of the loop is wrapped round the main wire and bent to engage* $\lceil\overline{6}$, *returning to the main wire to be wrapped round it.*

Fig. 5*a*. *Plate used in Fig.* 5.
Compare with Fig. 6 *in which no space was lost.*

and their relation to one another. Size I have already referred to ; but the shape of the upper arch can be altered permanently to conform to the lower arch when it is brought forward and remains forward in Class II. Div. I cases. Some doubt the permanency of a change in position of the mandible in relation to the maxilla : my experience is that it can be changed permanently. In Class III cases it can be changed at 2 to 6 years of age (*Fig.* 3) with scarcely any treatment of teeth, except to eliminate the overbite for a brief period. In many such cases there can be no suggestion that it is the result of change of tooth position ; at a later period a similar result is obtainable by means of intermaxillary traction. If this is possible, why not the reverse ; I have shown a case treated at ages 7-8 to 11-12, and the same case again at age 22.[9] *Fig.* 4 shows a similar result in which there has been no relapse. I do not think this is a case in which the result can be ascribed entirely to a change in position of teeth. Whilst not 100% of these latter cases are successful, the percentage is so great that I do not hesitate to advise treatment on these lines, which involve the least amount of tooth movement.

It would seem that not all practitioners are satisfied with such results. In the States paticularly, other " philosophies " are being advocated ; one is the removal of the four first premolars[10] ; another is the moving back of all the upper teeth after loss of the second upper permanent molars[11] and another the same without extraction.[12] Whilst one reads good reports of these methods, have they been in use long enough to prove their worth ? I doubt it. Both involve very considerable tooth movement with appliances. I do not think such extensive movements are in the best interests of the health of the teeth and their longevity. Here, then, is another subject for research.

Fig. 7 shows an apparent change of arch relation as a result of grinding incisors.

Distal Movement of First Permanent Molars. (*Fig.* 5).

I have done relatively little to correct medial drift of first permanent molars. I think this may be difficult unless one puts in an appliance for this purpose only. In the upper it can usually be dealt with by loss of a tooth, or if the case is a post-normal one, treated with a fixed appliance and intermaxillary traction ; this can be arranged to move the first permanent upper molar distally.

In the lower arch extraction is not advisable in very many cases, and whilst in the course of treatment with fixed appliances I arrange these to increase the space for the premolars, I have not met with marked success ; the anchorage and application of force is unsuitable unless the appliance is designed for this one movement in particular ; I am uncertain of the ultimate effect of distal movement

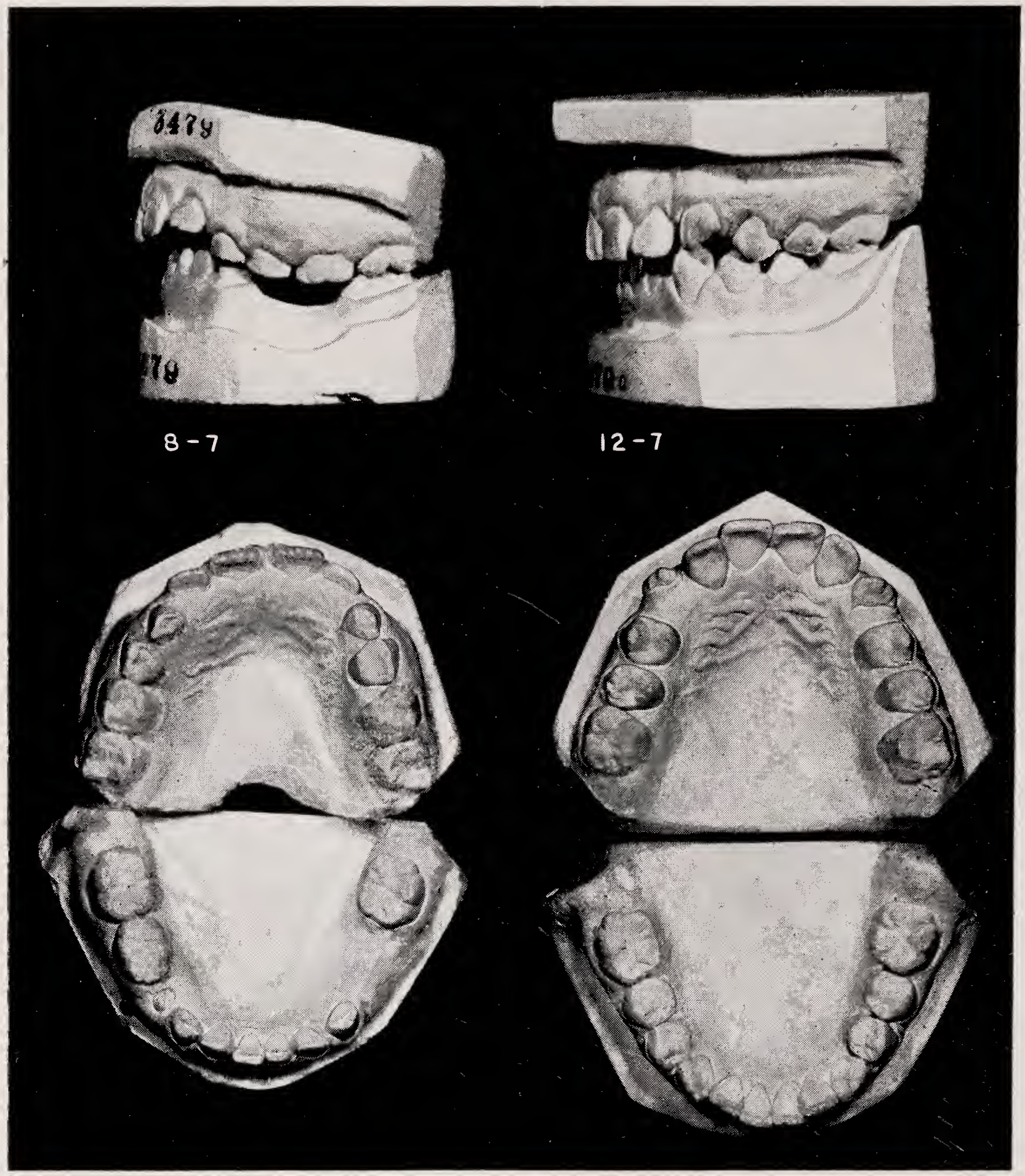


Fig. 6. *Case No.* 3479. F. (*above*).

Age 8-7 *Shows effect of finger sucking* (*sucked left index finger by putting knuckle in the mouth and tip of finger just out of mouth ; the sucked finger was almost entirely flexed and bitten on ; it was put in unconsciously when asleep*). *Habit ceased. Note early loss* $\overline{|\,de}$.

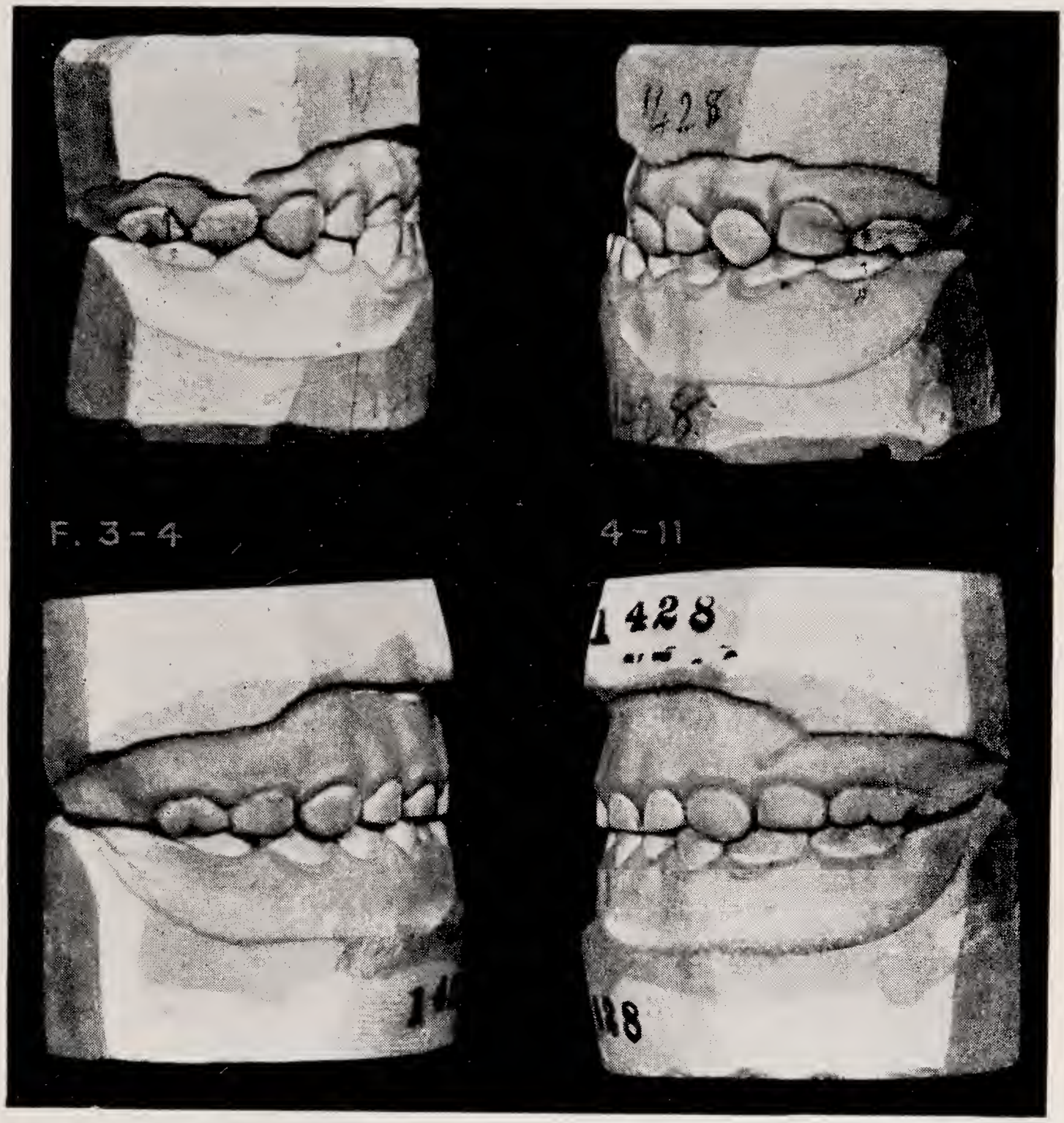
Age 10-2. $\overline{|\,26}$ *space* 21 *mm.. at least* 1 *mm. greater than at age* 8-7. *No treatment.*

Age 12-7 $\underline{3\,|\,3}$ *erupting considerably rotated. A removable appliance with labial and lingual wires and wrapped auxiliary spring to press on the appropriate corners. This appliance was satisfactory but was lost and replaced by a fixed appliance which perhaps is rather more efficient ; similar types of springs used.*

Fig. 7. *Case No. L.H.* 1428. F. (*right*).

Age 3-4. ? *ClassIII* $\overline{c\,|\,c}$ *too medial to* $\underline{c\,|\,c}$ $\overline{ba\,|\,a}$ *labial to* $\underline{ba\,|\,a}$: *all other labio-lingual and bucco-lingual relations correct. Very small arches. Incisors ground : this repeated one month later.*

Age 4-11. $\overline{c\,|\,c}$ *now in correct relation with* $\underline{c\,|\,c}$. *Incisors are edge to edge, the upper ones being very slightly labial to the lower ones.* $\underline{c\,|\,c}$ .5 *mm. wider :* $\overline{c\,|\,c}$ 2.5 *mm. wider. Appearance of teeth greatly improved though the crowding remains but the Class III condition* (*if it were such*) *has disappeared.*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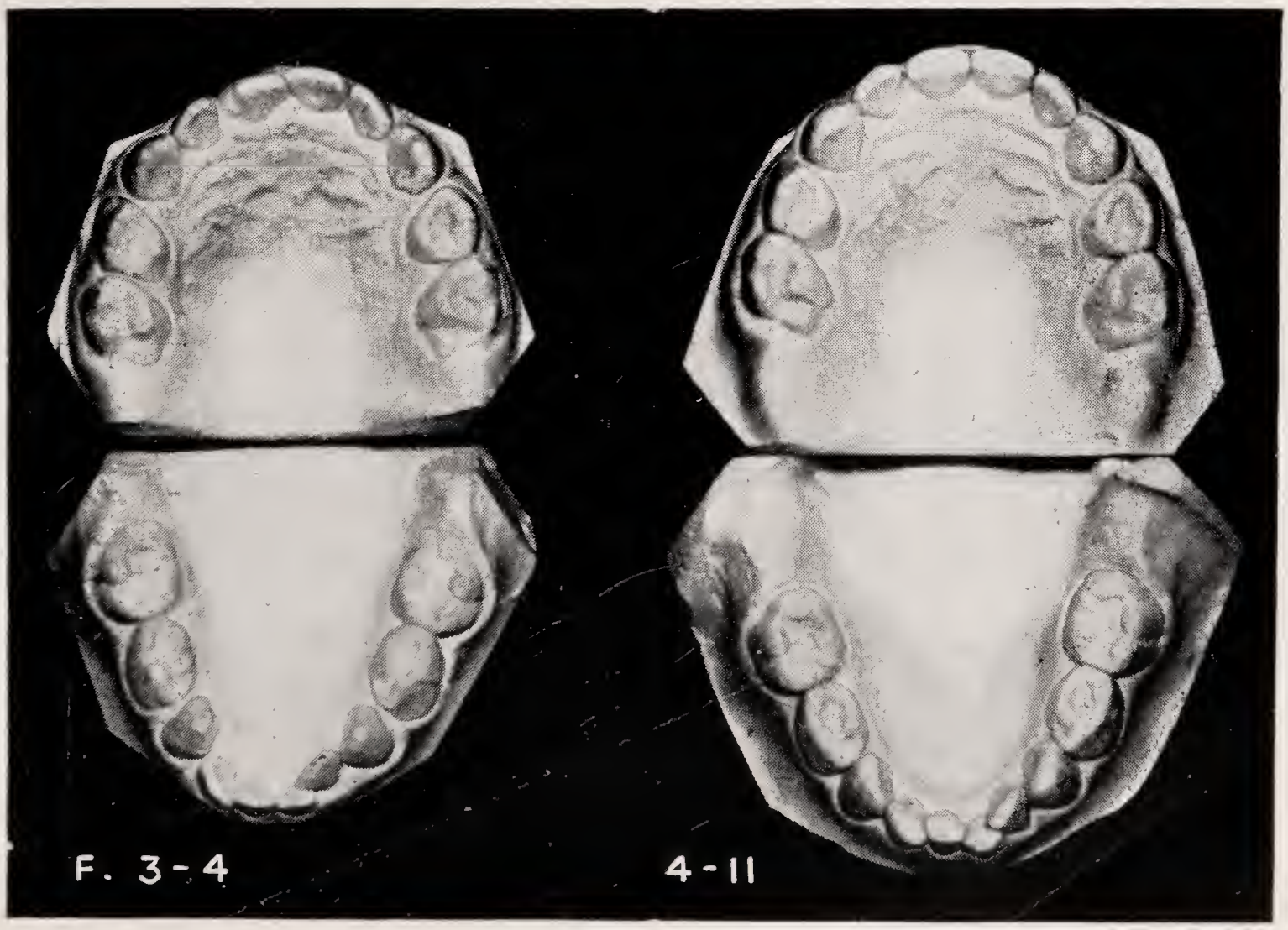
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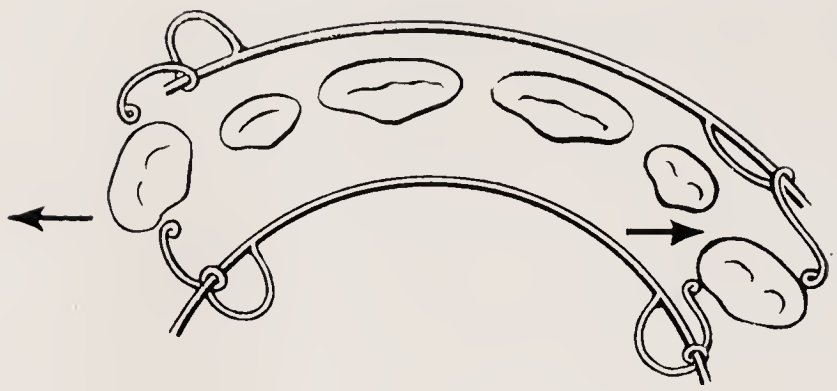

Appliance mentioned in Fig. 6

of such lower molars, though it is these which call for such treatment in the majority of cases.

In *Fig.* 5 a case of Class II. Div. I type but only to such slight extent that treatment for post-normality may not be necessary, the left lower first permanent molar had drifted forward as a result of premature loss of the second deciduous molar. It is desirable to keep all the teeth in good alignment in this case, so the removable appliance described was used. This worked very satisfactorily ; the plate was used for this one purpose ; all the other teeth were present and provided anchorage. It would have been simpler to have preserved the space as soon as it was found $\overline{6}$ had drifted far enough. I advise the use of space retainers more frequently in the lower than in the upper arch. In the type of case illustrated there is usually some distal and perhaps lingual, drift of the anterior teeth, which increases the loss of space and resultant crowding ; such spaces are not restored by lateral expansion.

Rotation of Teeth. (*Fig.* 6).

A number of rotated upper canines have been seen recently though there has been room for them in much better positions. It has been found possible to rotate these by means of auxiliary springs either on a removable plate or a fixed appliance. *Fig.* 6 shows the springs on a plate ; labially these may be placed vertically or horizontally, their adjustment must be very exact : this is facilitated by coiling the free end into a small circle. I prefer to wrap the springs round the base wire whether it is a plate or fixed appliance ; this makes them less liable to be displaced. These teeth are usually only partly erupted and as they erupt a thicker part of the tooth comes in contact with the springs and this will eliminate need for adjustment to some extent.

Upper incisors are easily rotated by this method. I prefer to band lower incisors, using a ligature engaging a spur on the outstanding corner, and, lingually, passing round an auxiliary spring on the lingual arch ; if necessary an auxiliary spring may be adjusted to move the instanding corner labially. The upper canines I refer to are usually insufficiently erupted to band, though when this is possible it is probably a more definite method.

In conclusion I quote from a letter headed "*Research in General Practice*" in *The Times* by Dr. John Pemberton : "The General Practitioner is especially well placed for carrying out research in social and preventive medicine. He sees illness in its earliest and therefore most remediable stages."[13] The same words apply to orthodontics. No one need feel that he or she cannot make a valuable contribution to our deliberations. New names on next year's programme are a welcome sign.

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DISCUSSION

The President said he thought there was no other member of the Society who could produce a paper showing the same combination of practical experience and theoretical knowledge as Mr. Chapman possessed. He had listened to the paper with the deepest respect and very great interest, and he had been delighted to hear Mr. Chapman's appeal for research by the ordinary member, because he believed that the research which an intelligent, diligent and enquiring practitioner could do was quite as important and valuable as any work done in the laboratory or with experimental animals ; it was, in fact, a necessary counterpart of that work.

Mr. Chapman had mentioned a number of problems which certainly cried aloud for solution. He would be particularly interested to know what harm was done by the bands which were forced down upon the molars at a tender age. The gum should not be detached from the enamel at that age. By means of the epithelial attachment it should be adherent to the enamel about halfway up the side of the tooth, especially in any interdental space that might exist. It would be very surprising if some harm was not done by the bands to which he had referred, but it was not known whether or not any harm was done by them.

He would like to ask whether Mr. Chapman thought that whether the suture between the two sides of the premaxilla being united or not had an influence on whether the central incisors would stay together when they were moved together. What did Mr. Chapman think of the operation suggested by Sir Harold Gillies for such cases, namely, to take out a wedge of bone from in between the two teeth and place them together ? Did he consider that proper or not ?

Mr. K. E. Pringle said Mr. Chapman might be interested to know that, when he was talking to some post-graduate orthodontic students in America, he had shown them a copy of the Society's Transactions for 1936 and they had said : " Really, this is very extraordinary ; here is Mr. Chapman talking about basal bone as long ago as that ! "

Mr. H. G. Watkin said that Mr. Chapman had made many very useful suggestions in his paper.

In regard to the case which Mr. Chapman had shown with lingually placed lower incisors, did he think that there had been a very tight frenum ? He had had a similar case with very crowded lower incisors caused by the tongue, and after he had removed the frenum they had straightened up very well.

As to the case of the contracted lower arch, he thought that could be caused by the child leaning his head on his fist and pushing the lower arch in with external pressure. The size of the tongue had a very great influence on the size of the arches. If the arches were separated the size of the tongue should be reduced. If the arches were crowded the number of teeth should be reduced.

Mr. J. H. Hovell said that it was with some diffidence that he took part in the discussion, because Mr. Chapman was a master of the art and science of orthodontics. Mr. Chapman had pointed out in his paper many truths of which all orthodontists ought to be aware but which were often missed.

In regard to the possibility of changing the position of the mandible, which also involved changing its shape, he did not think it was possible to establish from models whether that had been done or not. He thought it could be established only by means of a survey, and he therefore thought that it would be necessary to wait some time to know whether Mr. Chapman or he was right in the matter.

In regard to the model shown by Mr. Chapman in which the upper teeth appeared to have adequate space and yet the lower incisors were imbricated, he thought that could be explained without assuming that there was a difference in the tooth tissue in the upper and lower jaws. He thought the case was one in which the lower basal bone was in prenormal relationship with the upper basal

bone, and therefore the lower dental arch, in order to attain a normal relationship with the upper dental arch, was distally positioned upon the lower basal bone, which resulted in the tipping backward of all the lower incisor teeth. He thought Mr. Chapman would find, by taking the angle of the lower incisors to the mandibular plane, that they were very considerably retroclinated.

Mr. B. T. Broadbent said he thought that the question of occlusal relationships and basal relationships had been covered by Mr. Thompson in his paper on the rest position of the mandible, in which he pointed out that very little could be done to alter the rest position of the mandible, by which he meant the mandible in the position where the muscles closing and opening the mandible were in a state of balance. He went on to point out that the occlusal relationships were learned relationships and that what the orthodontist had done when he had produced a mandibular movement forward was to provide the child with a new learned occlusal relationship, and the child had a muscular response which was learned rather than an involuntary response.

He had done a number of experimental cases at Manchester with simple bite plates to find out whether the child came to a new mandibular position, and he had found that in twenty or thirty Class II cases the child's mandible came forward from the rest position to a new occlusal position in which the condyle was not retruded completely into the fossa.

Miss L. Clinch asked Mr. Chapman whether he found any difference in the result when he expanded an arch with a Badcock plate and when he expanded it with a fixed appliance carrying very weak auxiliary springs. She had found that, if she put in a Badcock plate and then took the plate out and wanted to make a new one, it was essential to put in some kind of retention or to let the child continue with the Badcock plate until the new one was ready to put in, because the relapse was so rapid. On the other hand, if she put in a fixed appliance with weak auxiliary springs, she found that she could take it out after the expansion had occurred, take an impression there and then, and wait two months before putting in the next plate, which might be a bite plate or something of that sort, and that plate would fit. She was quite sure that that would not be the case when a Badcock plate was used. She did not know whether it was that, with the springs, the teeth were allowed to move when they wanted to and were not forced, whereas with a Badcock plate they were forced and therefore a tilt occurred.

Mr. R. E. Rix, referring to the case shown by Mr. Chapman in which the lower incisors were imbricated and the upper incisors seemed to be in normal position, said he did not think there was any need to argue whether the apical base of the lower dental arch was too far forward in relation to the apical base of the upper dental arch, if there was an excessive incisor overlap, as there appeared to be. With an excessive incisor overlap, the incisal edges of the lower front teeth could not go forward so far as they could when the incisor overlap was slight. He would like to know whether Mr. Chapman had found an excessive incisor overlap in the case in question.

Mr. C. L. Endicott, referring to Mr. Chapman's statement that he found Class III cases the simplest to treat, asked whether he made any distinction between the different types of Class III cases. Personally he found the true Class III cases anything but simple, and when he saw a very bad true Class III case he admitted at the start that he thought he was going to face defeat. The pseudo or symptomatic Class III cases seemed to respond very satisfactorily to treatment.

In regard to the question of changing the position of the mandible, that was certainly a problem which needed to be solved and he hoped that it would be solved before very long.

He was very glad that Mr. Chapman had referred to the grinding of deciduous teeth. He did that a great deal, and he would like to ask Mr. Chapman whether he thought there was anything against grinding deciduous teeth in the late stages of the transition, rather than doing any expansion of the arches. He often liked

to grind the cusps of both upper and lower molars quite freely.

Mr. Harold Chapman, in replying to the discussion, said he agreed with the President that clinical research was a necessary counterpart of laboratory research, and he thought that what the President had said should encourage those who had not the opportunity to do laboratory research to carry out clinical research.

In regard to the bands to which the President had referred, in the case of a first permanent molar at about 9 years of age the gum could be level with the occlusal surface distally and yet one could fit a band of 3/16 inch on the tooth by cutting out only a small festoon. He did not know whether the epithelial attachment was cut in those cases ; he assumed, from what he had read about the epithelial attachment, that it was, yet one could fit the band, without causing any pain or discomfort, in the case of a child 9 years of age. He thought, however, that from the point of view of the health of the tooth it was better not to put on the band.

The President had referred to the damage done by putting bands on the teeth, and, in regard to that point and to the operation suggested by Sir Harold Gillies, which the President had mentioned, he would say that he could not imagine why the instrument which Sir Harold Gillies described as a circular saw in an engine was used.

In the case to which Mr. Watkin had referred, he could not remember the condition of the frenum.

He had been very pleased to hear the remarks made by Mr. Hovell and Mr. Broadbent on the change in position of the mandible. It was in order to hear their views on the subject that he had shown the cases on the screen.

Whilst there might be some doubt about the Class II cases, there seemed to be less doubt about the Class III cases, because there was so little pressure in the one that he had shown and he believed that it was a true Class III case of a very mild character. No teeth had been lost and there was practically no pressure on the teeth. In the very first case that he had treated with a head and chin cap, the upper and lower incisors were some distance apart originally and the child wore the head and chin cap until the incisors came into contact and the continual pressure moved back the upper incisors. They passed over ten days after he had opened the bite. He thought that in the case which he had shown it must have been the lower that went back, because there was no force at all on the upper. On the other hand, the child was very young—under 2 years of age—when the treatment was started.

When he said that Class III cases were the easiest to treat, he was thinking of the final result, which in those cases was nearly always retained. If the relationship of the teeth could be corrected, it would remain corrected. The question of age was very important. The cases which he had shown were of very young children, 6 years and under, but even up to 9 or 12 years of age the treatment was relatively easy. After that it became much more difficult, and at 14 or 15 it became very difficult. He had, however, shown one case which was very bad, yet the treatment had been successful.

He thought that grinding of deciduous teeth in the right place was a very valuable form of treatment, and he did not think any harm had been done in the cases that he had shown ; in fact, he thought some good had been done. Anyway, the relationship of the teeth had improved. Whether it would improve to the same extent when the permanent teeth erupted he did not know. Unfortunately in all such cases the orthodontist could not eat his cake and have it ; he had either to treat the case and see what happened or leave it untreated and see what happened.

On the motion of **The President**, a vote of thanks was accorded to Mr. Chapman for his paper.

* * * * *

PRESIDENT'S VALEDICTORY ADDRESS

The President: I wish to thank you all for your forbearance with my many shortcomings during the past year and to say how grateful I am to the members of the Council for the assistance which they have given me. Many of you may not realise how much work the Council does. It increases year by year, and it threatens to become a very serious burden, partly owing to the growth of the Society in size and partly owing to the difficulties which we all experience nowadays, when about three times as much work is needed to get anything done as was required in pre-war days.

I especially want to express my thanks to Mr. Pringle, our retiring Secretary. His work is at least partly known to you. He is the man behind the scenes who makes the wheels go round, and he has maintained the very high standard which was set by Mr. Cutler during a long period.

Another officer of the Society who is retiring is Mr. Pilbeam, our Editor. It is very largely owing to him that we have any Transactions at all. They have been a great burden on the Council, and Mr. Pilbeam has borne the greater part of that burden. The Transactions have been mainly the result of his endeavours.

Mr. Cutler is retiring from the Council, where his work has been in line with all the other work that he has done for the Society for very many years.

I think the Society has had a good year. We have had some excellent papers. I should like to see more of the younger members taking part in the discussions and asking questions. There is always such a friendly atmosphere at these meetings that no one need be afraid to do so, even though he speaks in the presence of the greatest authorities on orthodontics in this country.

I have now the very pleasant duty of handing over my badge of office to the President for 1949, Mr. Russell Marsh. It is hardly necessary for me to introduce Mr. Russell Marsh to you, because I think that nearly all of you have heard him read papers from time to time, which he does with a remarkable wit and aplomb. He has been for many years Honorary Dental Surgeon and Lecturer in Orthodontics at King's College Hospital, and he is a Fellow in Dental Surgery of the Royal College of Surgeons. His work is known not only in this country but internationally, and he has been Honorary Secretary of the European Orthodontic Society.

I hand over my office to him with every good wish and in the firm belief that next year we shall see him shine in this position as he has never shone before.

Professor Rushton then inducted Mr. Russell Marsh into the Presidential Chair and invested him with the badge of office.

The President thanked Professor Rushton for the kind words that he had said about him, and the members for the way in which they had received him.

VOTE OF THANKS

In proposing a vote of thanks to the retiring President, Professor Martin Rushton said that to do justice to this I wish I possessed the eloquence displayed by Mr. Cutler when just a year ago with such well chosen words he introduced Dr. Rushton and inducted him to the Chair.

Your Secretary was warned that there are many present who could express so much more ably on your behalf the thanks we desire to give to Professor Rushton.

In spite of the lack of opportunity to think a little, about such an important vote of thanks, it is nevertheless with special pleasure that I enjoy the privilege of expressing on behalf of the Society our gratitude and thanks to Professor Rushton for all that he has done for us in a most successful year of office. I am fortified with the knowledge that with his customary modesty, as we noted again in his valedictory address, and his forbearance and tolerance he will overlook my shortcomings in anything I may say or leave out.

Professor Rushton is so well known to all for his high academic achievement. He is famous not only for his erudite contributions to the British Society for the Study of Orthodontics, but to the science and Practice of dental surgery in its widest compass and perhaps in particular to Oral Surgery and Oral Pathology and Dental Medicine for which he is doing so much with such outstanding achievement and distinction. One could so easily continue for a long time to say the nicest things of a great man and you will wish me to include how much we enjoy his genial and friendly personality.

It remains for me to say in conclusion how very much we regard Professor Rushton with affection and high esteem. I am honoured to have been your spokesman in this special vote of thanks, and ask you to endorse it in the customary manner with hearty acclamation.

Dr. L. Lindsay, in seconding the vote of thanks, said that the Society had been greatly honoured by having Professor Rushton as its President.

The vote of thanks was accorded with acclamation, and the meeting then terminated.

* * * * *

REPORTS OF MEETINGS.

An Ordinary Meeting of the Society was held at Manson House, 26, Portland Place, London, W.1, on Monday, 12th January, 1948, at 8 p.m. Professor M. A. Rushton, President, occupied the Chair.

The Minutes of the Annual General Meeting, held on December 1st, 1947, were read and confirmed and signed.

The President, referring with regret to the death of Mr. William Francis Mellersh, said that Mr. Mellersh had been one of the original members and the first Treasurer of the Society and had been its President in 1915.

The meeting stood in silence for a few moments.

The President welcomed the visitors who were present.

* * * * *

An Ordinary Meeting of the Society was held at Manson House, 26, Portland Place, London, W.1, on Monday, 9th February, 1948, at 8 p.m. Professor M. A. Rushton, President, occupied the Chair.

The Minutes of the previous meeting, held on 12th January, 1948, were read and were confirmed and signed.

The President welcomed the visitors who were present and expressed the hope that they would take part in any discussion that occurred.

The following new members were introduced to the President:
Mr. C. P. Adams and Miss L. M. J. Ewart.

The following candidates for membership of the Society were elected *en bloc* by show of hands:—

C. D. W. Eddowes, L.D.S., Trinity Terrace, Derby.

E. Elwyn Lewis, L.D.S., Dental Department, 92, Bath Road, Hounslow.

B. C. Leighton, H.D.D., L.D.S., Dental School, Hospitals Centre, Birmingham, 15.

D. Maclachlan, H.D.D., L.D.S., 2, Douglas Road, Harpenden, Herts.

W. A. Nicol, L.D.S., 62, Forsyth Street, Greenock.

J. G. Owen, B.D.S., 60, Broadwater Road, S.W.17.

P. Maxwell Stephens, L.D.S., 12, Lascelles Terrace, Eastbourne.

E. H. F. Webb, L.D.S., 17, The Grove, N.3.

D. S. Hayton-Williams, L.D.S., 101, Banbury Road, Oxford.

R. Hotz, 20, Freigutstrasse, Zurich, Switzerland. (*Corresponding Member*).

* * * * *

An Ordinary Meeting of the Society was held at Manson House, 26, Portland Place, London, W.1, on Monday, 8th March, 1948, at 8 p.m. Professor M. A. Rushton, President, occupied the Chair.

The Minutes of the last Ordinary Meeting, held on 9th February, 1948, were read and were confirmed and signed.

The President said that he had two invitations to announce from other orthodontic societies. One was from the European Orthodontic Society, which was to hold a meeting in London, on July 16th, 17th and 19th. Any non-members of that Society who wished to attend the meeting or to join the Society should communicate with Mr. Russell Marsh, the Honorary Secretary. The second invitation was from the French Orthodontic Society, which was to hold a meeting in Paris from May 6th to May 9th. Members of the British Society were invited to take part in that meeting and to give demonstrations, and any who would like to do so should communicate with Mr. Russell Marsh.

There were some visitors present that evening, and he wished, in the name of the Society, to welcome them and to invite them to join in the discussion which would follow the paper.

The following new members were introduced to the President :—

The following candidates for membership of the Society were elected *en bloc*, by show of hands :—

Miss M. A. Macdonald, L.D.S., 38, Green Lane, Hendon, N.W.4.

James Allen, L.D.S., B.D.S., 42, Dunster Road, West Bridgeford, Notts.

G. Brocas Hunter, B.D.S., H.D.D., D.M.D., 20, Ramshill Road, Scarborough, Yorkshire.

S. P. Johns, B.D.S., L.D.S., 3, Abingdon Gardens, W.8.

A. E. W. Miles, L.R.C.P., M.R.C.S., L.D.S., London Hospital Medical College, Turner Street, E.1.

R. P. Powell, L.D.S., 98, Gloucester Road, S.W.7.

J. .W Tulley, B.D.S., L.D.S., 121, Honor Oak Park, S. E.27.

K. M. Hellen, C.M., O.L., Helsingfors, Finland (*Corresponding Member*).

* * * * *

An Ordinary Meeting of the Society was held at Manson House, 26, Portland Place, London, W.1, on Monday, 11th October, 1948, at 8 p.m. Professor M. A. Rushton, President, occupied the Chair.

The Minutes of the meetings held on 8th March and 10th May, 1948, were read and were confirmed and signed.

The President announced with great regret the death of Mr. Hubert Visick, a very old and well loved member of the Society. Mr. Visick had been, he said, a very active member also, having read communications of great interest on many occasions and having served as a Vice-President and as a member of the Council.

The members and visitors stood in silence for a few moments in memory of Mr. Visick.

The President then welcomed the visitors who were present and invited them to contribute to any discussions that might take place.

The following candidates for membership of the Society, who had been approved by the Council, were elected *en bloc* by show of hands :—

Miss Margaret C. Bromley, Clovelly, 28, Carwood Avenue, Bramhall, nr. Stockport.

E. H. Carroll-Clark, 136, Fulham Road, South Kensington, S.W.3.

Mrs. C. M. Figgis, 93, Harley Street, W.1.

J. H. French, 47, Church Road, Hove.

D. F. Glass, 4, Elwick Road, Ashford, Kent.

W. B. W. Greig, 86, Brook Street, Grosvenor Square, W.1.

J. R. Halden, 14, Crescent Court, The Crescent, Surbiton.

D. T. Hartley, Turner Dental School, Bridge Street, Manchester.

Miss Eileen C. McGuire, 43, The Avenue, St. Margaret's-on-Thames, Middlesex.

P. T. Parr, Le Chalet, Harwood Green Road, Pembury, Kent.

A. S. Peacock, Medical Department, Devon County Council, 4, Barnfield, Exeter, Devon.

H. S. R. Sarson, The Bungalow, The Green, Tadworth, Surrey.

P. H. Tatchell, 1, Cantelupe Road, Bexhill-on-Sea.

K. D. Watts, Claremont, Old Stratford, Bletchley.

Miss Elizabeth M. Webster, 19, Royal Crescent, Glasgow, C.3.

The following newly elected members were introduced to the President and signed the Obligation Book :—

Mr. J. Allan, Mr. E. H. Carroll-Clark and Mr. P. Maxwell Stephens.

* * * * *

An Ordinary Meeting of the Society was held at Manson House, 26, Portland Place, London, W.1, on Monday, 8th November, 1948 at 8 p.m. Professor M. A. Rushton, President, occupied the Chair.

The Minutes of the previous Meeting, held on 11th October, 1948, were read and were confirmed and signed.

The President reminded the members that, while the Council would be putting forward nominations for Council office to the Annual General Meeting, members were entitled to make nominations under Bye-law 20, which said that nominations by post made by four properly qualified-members and received at least twenty-one days prior to the Annual General Meeting were to be accepted.

He welcomed the visitors who were present and invited them to join in any discussion which might take place.

The following new members signed the Obligation Book and were introduced to the President:

Mr. D. T. Hartley and Mr. Duncan Maclachlan.

The following candidates for membership, approved by the Council, were elected *en bloc* by show of hands:—

John Campbell, L.D.S., 74, Highburgh Street, Glasgow, W.2.

David Logie, H.D.D., 86a, Crown Street, Aberdeen.

James R. E. Mills, L.D.S., 27, Heath Road, Stockport.

Roy J. Sharland, B.D.S., 132, Denmark Hill, London, S.E.5.

D. I. Smith, L.D.S., 12, Elmhall Gdns, Wanstead, E.11.

Mrs. Rose E. Velden, M.D., 110, Regency Lodge, N.W.3.

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ANNUAL GENERAL MEETING.

The Annual General Meeting of the Society for the year 1948 was held at Manson House, 26, Portland Place, London, W.1, on Monday, 13th December, 1948 at 8 p.m. Professor M. A. Rushton, President, occupied the Chair.

MINUTES

The Minutes of the previous meeting, held on 8th November, 1948, were read and confirmed.

TIME OF MEETINGS

The Secretary said the members had been asked to say at what time they would prefer the Society's meetings to be held in 1949. Of those who replied, 19 had said 7 oc'lock, 16 8 o'clock and a small number 6 o'clock. The Council had therefore decided that the meetings should be held at 7.30, with the exception of the first meeting, which would be held at 8, in order to not clash with a meeting of the Odontological Section of the Royal Society of Medicine.

AMENDMENT OF BYE-LAW XII

The President moved on behalf of the Council that Bye-Law XII be altered to read as follows: "Every person elected an Ordinary Member shall pay an annual subscription of two guineas. The subscription of Corresponding Members shall be half a guinea less than that for Ordinary Members."

The reason for the alteration, he said, was that the annual subscription for Ordinary Members had been raised from one guinea to two guineas and the Council felt that overseas members, who could not attend the meetings of the Society and whose only benefit from membership was that they received the Transactions, should not be asked to pay two guineas but should pay a smaller subscription which would cover the cost of the Transactions.

The motion was carried.

ELECTION OF OFFICERS AND COUNCILLORS

The President, referring to the list of Councillors for 1949, as it appeared on the Agenda, said that the Council had nominated Mr. Parfitt in error, as he was ineligible, having been a member of the Council for a certain number of years. The Council desired to substitute the name of Mr. J. S. Beresford.

The Secretary read the following list of Officers and Councillors nominated by the Council to hold office during the year 1949:—

President	Mr. L. Russell Marsh.
Immediate Past President	Professor M. A. Rushton.
Vice-Presidents	Mr. H. T. A. McKeag. Dr. L. Lindsay. Miss L. Clinch. Mr. J. F. Pilbeam.
Secretary	Mr. Howell Richards.
Treasurer	Mr. Harold Chapman.
Curator	Mr. R. Ernest Rix.
Editor	Mr. C. F. Ballard.
Librarian	Mr. A. G. Taylor.
Councillors	Mr. J. H. Softley. Mr. K. E. Pringle. Mr. J. S. Beresford.

The President declared that, as there had been no other nominations, the members whose names had been read to the meeting by the Secretary were elected.

ELECTION OF TWO AUDITORS

The President said that the present Auditors were Mr. C. F. Ballard and Mr. T. L. Winn. As Mr. Ballard had now become Editor, it would be appropiate for another member to be elected Auditor in his place.

On the motion of Dr. Lindsay, seconded by Mr. E. A. Hardy, Mr. S. B. Newton was elected as one of the Auditors for 1949, and on the motion of Mr. Hovell, seconded by Mr. L. S. Levien, Mr. T. L. Winn was elected as the other Auditor for 1949.

REPORT OF THE TREASURER

The Treasurer (Mr. Harold Chapman) said that the Income and Expenditure Account for the year ended 30th September, 1948, showed an excess of income over expenditure of £136 13*s*. 5*d*., whereas in the previous three years there had been an excess of expenditure over income. This showed that the increase of the subscription to two guineas had been essential.

The cost of the Transactions for 1944/5 was £125 19*s*. 6*d*. He had thought it prudent to allow an estimated amount of £275 for the Transactions for each of the three years, 1946, 1947 and 1948, and a sum of £825 therefore appeared in the accounts for the Transactions for those three years. Since then, the account for the Transactions for 1947 had been received, and it totalled £476 7*s*. 0*d*. Therefore his estimate had been much too low, and the cost of the Transactions emphasised the impossibility of carrying on the Society at the previous subscription rate.

One new item in the accounts was Legal Charges. That was due to the Council's consideration of the question of incorporating the Society, in order to give it legal status. As the cost of doing that would probably be at least £150, the Council had decided not to proceed with the matter. Another new item in the accounts was the cost of the Northcroft Memorial Lecture, £41.

He had continued to allow depreciation on the cabinets and other furniture which the Society possessed.

He moved the adoption of the report.

Mrs. Michaelis seconded the motion.

Mr. L. S. Levien congratulated the Treasurer on his report and asked whether it would be possible for the statement of accounts to be sent to the members before the Annual Meeting.

The Secretary said that all the members should have received a copy of the accounts with the Agenda for the present meeting.

Other members said that they also had not received the accounts, and **The Secretary** said that he would make a note of this and the matter would be rectified on future occasions.

The report was adopted.

REPORT OF THE SECRETARY

The Secretary (Mr. K. E. Pringle), in presenting his report and moving its adoption, said that since the last Annual General Meeting there had been four deaths and fourteen resignations and forty new members had been elected. The membership to-day was 255.

Seven meetings had been held during the year, with an average attendance of eighty-one, which was a sign that the year had been a successful one, particularly since at the Demonstration Meeting in May the attendance had been limited to members.

He wished to conclude his report on a personal note. After three years he was relinquishing the office of Honorary Secretary, and during those three years what was practically a new Society had been formed, for 152 new members had been elected. He hoped they would bring to the Society the results of their work as those results accumulated. He was glad that during the year the readers of papers had maintained a standard which was the equal of any in the world and that the sole object of the Society, namely, the study of orthodontics, had been kept fully in view.

He was very grateful to the members and the council for the consideration which they had shown to him, and particularly to the three Presidents, Mr. Rix, Mr. Cutler and Professor Rushton, for their unfailing help. Mr. Howell Richards who was now to take over the full duties of Honorary Secretary, had acted as

Assistant Secretary during the past year, and he wished to thank him for the great help which he had rendered in that capacity. He also wished to thank Mr. Chapman and Mr. Gordon Taylor for carrying on his work as Honorary Secretary whilst he was in America.

The motion for the adoption of the report was seconded by Mr. Hardy and was carried.

REPORT OF THE LIBRARIAN

The Librarian (Mr. A. G. Taylor) reported that during the past year the volume of borrowing had shown a decline, but it should be borne in mind, he said, that the previous year had been a record one in that connection. The Society had not received any gifts of books during the year.

The Society received the Journal of the American Dental Association, the Angle Orthodontist, the American Journal of Orthodontics and the Archives of Orthodontics.

The catalogue of the Library was in an advanced stage of preparation. He hoped that the Transactions for 1946 and 1948 would be published within the next four or five months, and he would then be able to complete the index of the Transactions. The catalogue would then be published and sent to all the members.

He moved the adoption of the report.

Mr. K. E. Pringle seconded the motion.

The President said he was sure all the members would be very pleased to know that the Librarian was compiling a catalogue of the Library, which would be of great help to them when they were seeking material.

The motion was carried.

REPORT OF THE CURATOR

The Curator (Miss L. Clinch), in presenting her report and moving its adoption, said that during the past year models had been received from Dr. Lind-say, Professor Friel and Mr. Morris. Dr. Lindsay had also presented a skull aged about 8 years, which was the first skull the Museum had obtained. She hoped that it would form the beginning of a good collection. Unfortunately, at present the Museum had no cabinet suitable for showing such material.

The Museum now possessed photographs of all the Past Presidents of the Society, with four exceptions.

The motion for the adoption of the report was seconded by Mr. Watkin and was carried.

ELECTION OF AN HONORARY MEMBER

The President proposed on behalf of the Council that Mr. G. F. Cale-Matthews be elected an Honorary Member of the Society. He was sure that all the members had a great regard for Mr. Cale-Mathews, who was a Past President of the Society and had rendered great service to it by the excellent papers which he had read and in many other ways.

The motion was carried.

WELCOME TO VISITORS

Visitors were then admitted and were welcomed by **The President,** who invited them to take part in any discussion and to consider themselves members of the Society for the evening.

INTRODUCTION OF NEW MEMBERS

The following new members, present for the first time since their election, signed the Obligation Book and were introduced to the President, who admitted them to membership :

Mrs. M. C. Brock, Mrs. C. M. Figgis and Mr. David Logie.

ELECTION OF AN ORDINARY MEMBER

The following candidate for membership of the Society was elected by show of hands :—

Mr. Anthony Paul Demajo, D.D.S., Malta, Guy's Hospital Dental School, London, S.E.1.

* * * * *

THE BRITISH SOCIETY FOR THE STUDY OF ORTHODONTICS

INCOME AND EXPENDITURE ACCOUNT for the Year ended 30th September, 1948

1947 £	s.	d.			£	s.	d.	£	s.	d.
10	10	0	To Storage Rent					10	10	0
19	10	6	,, Repairs					–	–	–
81	15	11	,, Printing and Stationery		£ 55	4	11			
400	0	0	,, Reserve for Cost of Transactions		252	14	6			
								307	19	5
23	7	8	,, Postage					22	14	8
6	15	0	,, Lantern and Film Expenses		6	0	0			
48	3	0	,, Hire of Hall		45	0	0			
42	0	0	,, Reporting		29	8	0			
52	18	4	,, Refreshments		53	0	0			
4	16	6	,, Lighting Demonstration Meeting		5	6	0			
								138	14	0
1	10	3	,, Telephone and Telegrams						4	4
	9	0	,, Travelling Expenses						4	6
5	5	0	,, Audit and Accountancy					5	5	0
3	4	3	,, Insurance					3	4	6
2	8	0	,, Journal—A.D.A.					2	8	0
–	–	–	,, Legal Charges					10	10	0
–	–	–	,, Presentation Mrs. Phebey, secretary to Hon. Sec.					10	0	0
			,, Honorarium—Professor J. E. Harris		26	5	0			
–	–	–	,, Printing		14	19	0			
								41	4	0
14	8	2	,, Sundries					1	0	6
30	11	6	,, Depreciation—Furniture and Office Equipment					30	11	6
–	–	–	,, Excess of Income over Expenditure for year to date					136	13	5
£747	13	1						£721	3	10

1947 £	s.	d.		£	s.	d.
328	13	0	By Members' Subscriptions	691	8	6
7	7	0	,, Sales of Transactions	–	–	–
–	–	–	,, Accrued Interest on Saving Certificates	12	10	0
17	5	4	,, Interest on 2½% Consolidated Stock	17	5	4
				29	15	4
394	7	9	,, Excess of Expenditure over Income for year to date	–	–	–
£747	13	1		£721	3	10

THE BRITISH SOCIETY FOR THE STUDY OF ORTHODONTICS

BALANCE SHEET as at 30th September, 1948

1947 £ s. d.		£ s. d.	£ s. d.
	Accumulated Fund :—		
	Balance at 1st October, 1947	1,481 9 4	
	Add: Excess of Income over Expenditure for year to date	136 13 5	
1,481 9 4			1,618 2 9
	Creditors :—		
	Transactions 1944/45 ..	125 19 6	
700 0 0	Transactions 1946/48 (Estimated by Hon. Treasurer) ..	825 0 0	
20 4 9	Printing	9 17 4	
14 8 0	Hire of Hall	22 10 0	
7 17 6	Storage Rent	7 17 6	
10 10 0	Reporting	– – –	
5 5 0	Refreshments	10 0 0	
2 2 0	Sundries	5 6 0	
– – –	Transactions sold in advance	2 2 0	
11 0 6	Subscriptions in advance ..	8 18 6	
			1,017 10 10
	Petty Cash :—		
2 1 8	Overdrawn		– – –
£2,254 18 9			£2,635 13 7

1947 £ s. d.		£ s. d.	£ s. d.
	Furniture and Office Equipment—		
	Balance at 1st October, 1947	580 18 6	
580 18 6	*Less*: Depreciation at 5% per annum	30 11 6	
			550 7 0
	Debtors :—		
2 2 0	1948 Subscriptions received since 30th September, 1948		13 13 0
	Investments :—		
	500 National Savings Certificates, seventh issue at cost	375 0 0	
	Add: Accrued Interest to date	12 10 0	
375 0 0		387 10 0	
	£691 5*s.* 10*d.* 2½% Consolidated Stock at Cost ..	575 14 0	
575 14 0	(Market Value – £539 6*s.* 2*d.*)		963 4 0
721 4 3	Cash at Bank		1,104 14 2
	Cash in Hand :—		
	Hon. Treasurer	3 6 10	
	Hon. Secretary	8 7	
			3 15 5
£2,254 18 9			£2,635 13 7

Certified in accordance with the Books and Vouchers of the Society.
We have verified the Investments and Cash at Bank.

Fredk. B. Smart & Co.
Chartered Accountants,
22, Queen Street,
London, E.C.4.

4th November, 1948.

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